



Lethbridge
Undergraduate
Research Journal

ISSN 1718-8482



[Home](#) | [Current Issue](#) | [Editorial Board](#) | [Instructions for Authors](#) | [Contact](#)

Lethbridge Undergraduate Research Journal
ISSN 1718-8482

The Female Contribution to the Origin of Life Sustaining Tools

Kimberly Wilbanks

Pierre Laclède Honors College
University of Missouri - St. Louis
St. Louis, Missouri, U.S.A.

Citation:

Kimberly Wilbanks: The Female Contribution to the Origin of Life Sustaining Tools . *Lethbridge Undergraduate Research Journal*. 2008. Volume 3 Number 1.

Table of Contents

[Introduction](#)
[Nonhuman Primate Females' Time, Energy, and Reproductive Strategies](#)
[The Evolution of Tool Use](#)
[Conclusion](#)
[References](#)

Introduction

In 2006 primatologists Jill Pruetz and Paco Bertolani witnessed a savannah chimpanzee (*Pan troglodytes verus*) in Senegal locate a cavity in a tree branch and then fashion a broken branch into a spear by stripping it of limbs and gnawing the tip into a point (Pruetz & Bertolani, 2007). Following this process, the chimpanzee thrust the sharpened branch into the hole repeatedly, testing the end with its tongue every few jabs (Pruetz & Bertolani, 2007; Weiss, 2007). When the chimpanzee appeared satisfied, it stopped, climbed up the branch, and jumped on it until it broke revealing the motionless body of a bushbaby (Galago senegalensis), a prosimian primate weighing about half a pound, which it then extracted and ate (Pruetz & Bertolani, 2007; Weiss, 2007). This observation was one of 22 recorded cases, reported in the March 6th issue of *Current Biology*, in which chimpanzees were observed making spears and using them to hunt bushbabies.

This new observation is compelling to many theorists of human evolution not only because this is the first time tool use for hunting has been observed in any nonhuman animal, but also because this particular chimpanzee was a female. In fact, of the 22 cases of making and utilizing tools for hunting mammalian prey among the Senegalese chimpanzees (of which only one was observed to succeed) the majority was carried out by females and immature individuals (Pruetz & Bertolani, 2007). To researchers of human evolution this systematic crafting and utilization of a tool for the purpose of hunting is groundbreaking because as our closest genetic cousins chimpanzees are thought to provide a glimpse into how certain human characteristics developed during the course of hominin evolution. This cannot always be observed in the fossil record (Weiss, 2007). Chimpanzees exhibit behaviors similar to us, such as tool use, and examining the context in which those behaviors are carried out is important because it may point to specific selective pressures that helped to shape evolutionary change.

The fact that the majority of the tools were utilized by females directly counters the prevailing theory about human evolution in which males were the primary hunters and tool makers, and thus were the first to exhibit this behavior (Pruetz & Bertolani, 2007). These findings support the assertion made by some researchers that females played an important role in the evolution of tool production and use (Pruetz & Bertolani, 2007).

Why are chimpanzee females using tools for hunting more often than males? What pressures do these females face that would make them more likely to use tools? It is my assertion that female hominins played a large role in the evolution of tool use and innovation due to the greater environmental and biological pressures placed on them by their reproductive responsibilities. I plan to concentrate on the assertion, addressed by many proponents of the life-history perspective, that because of females' reproductive responsibilities they are more likely to use energy conserving tools for food gathering and processing such as carrying tools, digging sticks, tools for crushing or cutting plant products, and tools for manufacturing these tools (Slocum, 1975; Ward, 2006; Zihlman, 1981).

The impact of sex differences in human evolution has been the subject of varied and intense debate. The first interpretations of hominin fossils tended to uphold the cultural and religious philosophy of the time which dictated that

humankind was perverse and cruel, and that only strict rules and a moral upbringing could bring our base urges under control (Sussman, 1999). Raymond Dart, the scientist who first discovered the fossils of australopithecines in heaps of animal bones in caves in South Africa, was quick to assume that the trauma on the bones were signs of carnivory, extreme brutality, and cannibalism among our ancestors. Despite the later discovery that such heaping of bones in caves and the marks on them are actually indicative of hyena and leopard predation, many theorists today continue to advance the idea of the predatory and aggressive nature of our species (Sussman, 1999).

This image of human depravity was deeply connected with the common philosophy of human nature upheld by proponents of the Christian church, and therefore Western society in general at the time. Scientists were also part of this culture and subject to the same social influences that affect all human beings. In fact, many theorists actively endeavored to uphold the prevailing ideology. Dart's 1953 paper, *The Predatory Transition from Ape to Man*, includes a quotation from the seventeenth-century Calvinist Richard Baxter that vividly illustrates the connection between science and church philosophy: "of all the beasts the man-beast is the worst, to others and himself the cruellest foe" (Sussman, 1999: 455). Therefore, science followed religion and it was only natural that our first ancestors would be seen as predators rather than prey and that, unlike other primate species, we would excel intellectually and culturally because of our pursuit of blood and meat.

What did these philosophical arguments have to do with human sex differences and evolution? In none of the scientific discourses of the time was the role of women in the evolution of our species even considered. Male dominance and aggression were seen as the prime movers in human evolution (Slocum, 1975). Until relatively recently, Western society has been dominated by men who were almost entirely the only ones allowed to work within the sciences or outside the home in general. A woman's place was in the home or in certain gender-specific jobs, which were very rarely intellectually challenging. Men not only saw themselves as superior but as the only sex with any impact on society and the world in general. Women only exercised control and made contributions in private domestic spheres, and therefore their contributions were seen as having no value to those outside of the home, which often meant that the work of women was undervalued within the home as well (Ward, 2005). The role of women in child rearing and other domestic duties was seen as intellectually dull. The impact they had on the world through their primary roles as the caretakers of the next generation was often ignored and downgraded (Leacock, 1992). Therefore, it simply followed that women's contribution to the evolution of our species would be similarly overlooked.

The intellectual fusion of these cultural assumptions of humankind's basic depravity and of men's preeminence in the evolution of our species appeared in the 1968 book *Man the Hunter* edited by Richard B. Lee and Irven De Vore. This volume, containing articles by ethnographers and biological anthropologists (most notably the father of biological anthropology, Sherman L. Washburn), was widely accepted by the scientific community at the time and embraced by Western society at large. In this book, Washburn and C. K. Lancaster wrote one of the most influential articles in evolutionary theory, *The Evolution of Hunting*. In the article, Washburn and Lancaster asserted that hunting was the primary pursuit of males and was part of the division of labor within hunting and gathering societies. Ignoring the contributions of gatherers (i.e. women), they stated that hunting and "its total social, technical, and psychological dimensions" has been the primary shaper of our evolution "for hundreds of thousands of years" (Washburn and Lancaster, 1968: 293). They went so far as to claim that "in a very real sense our intellect, interests, emotions, and basic social life--all are evolutionary products of the success of the hunting adaptation" (293). They claimed that a large number of human traits were the direct result of this adaptation. These traits included the invention of language and elaborate tools, bipedalism, male aggression and the enjoyment derived from violence, the division of labor, the nuclear family and monogamy, the loss of estrus in women, an admiration of beauty, male bonding, and the creation of incest taboos (Fedigan, 1986). Indeed, the image they created of the lifeways of hominin ancestors looked much like an average Western household of the 1950s. In their conception, the males actively went out to find and bring back food, while the females stayed 'home' raising children and completing other domestic duties. The females were completely dependent on and subordinate to the males with whom they would exchange sexual and reproductive exclusivity for resources and protection (Fedigan, 1986; Hart and Sussman, 2005; Sussman, 1999). In this arrangement the male would know that he was provisioning *his* offspring, which would give him initiative to care for *his* female.

So what role did gathering have in this evolutionary model? None! Before women gained a foothold in the social sciences the prevailing theories were male oriented and completely disregarded or degraded the contributions of females on the progress of human evolution. Most proponents of *Man the Hunter* either simply did not mention gathering in their research or they openly denied that gathering could have had any impact on the evolution of humankind. Some even claimed that it was men who did the gathering, since the women stayed at the home base (Fedigan, 1986). When female researchers began to study anthropology and evolutionary theory they brought a totally different point of view to their disciplines, asking different questions.

Perhaps the first feminist reaction to *Man the Hunter* was the 1971 article *Woman the Gatherer*. In this paper, Sally Linton criticized Washburn and Lancaster's complete disregard for the contributions of women in human evolution. She presented a different view based on the central status of the mother-infant bond in all primate societies. She created an alternate explanation of human evolution in which the gathering, carrying, and food sharing of early hominin females with their young was the basis for food sharing, tool use and innovation, and the evolution of human cognitive capacities (Linton, 1971). Linton, as well as many feminist theorists after her, argued that baskets and slings for carrying infants and gathered food were the first tools invented by our hominin ancestors. She argued that hunting came far too late to spur the evolution of the human cranial capacity, language, culture, and tool-making. Rather than an image of a monogamous, nuclear family with a subordinate female, she envisioned the early hominin groups centered on the mother-infant bond which was expanded and strengthened by a lengthening period of dependence by the young and greater provisioning by the mother (Fedigan, 1986; Slocum, 1975). In this scenario, the first hunters would not have brought food home to their mates, but rather to their mothers and siblings. In other words, they shared with the individuals with whom they had the strongest bond and who had shared with them throughout their lives (Fedigan, 1986; Slocum, 1975; Ward, 2005; Zihlman, 1978).

Sally Linton and the theory of *Woman the Gatherer* became the catalyst for many feminist theorists who made their own unique contributions to our understanding of women's role in human evolution. Adrienne Zihlman, one of Linton's intellectual descendents, has greatly expanded our knowledge of the lives of our female hominin ancestors. Zihlman argued that the basis for hunting was gathering. She posited that food sharing expanded from mother-infant food sharing to include

adult offspring and siblings. Adult males would share meat with their mothers and sisters, who then would share their gathered foods. Eventually, food sharing expanded to include unrelated individuals within a group, which helped to ensure that all members were provided for. She asserted that hunting expanded from gathering and reciprocal food sharing because, even though hunting is time-consuming and "frequently yield(s) no food...individuals engaged in such activities, probably primarily males, would follow these pursuits because they were assured of a share of the food gathered by women with whom they had close social ties" (Zihlman, 1978: 18). Thus women made it possible for men to participate in an activity in which they would only occasionally succeed by assuring them a share of their gathered food and gathering, rather than being an intellectually dull activity, became the engine for the evolution of human intelligence and cultural accomplishment.

In her 1978 article, Zihlman not only made a compelling argument for the advent of hunting, but also described how adaptation (and ultimately evolution) could be shaped not only by environmental and biological pressures, but also by an intelligent animal's strategies in response to those pressures, which over time would alter the expression of evolutionary traits. This focus on active adaptation to pressures and demands throughout the life cycle of males and females within a species is a relatively new concept in the social sciences, and has been called the life-history perspective. Life-history theory is a broad conceptual framework that does not just focus on the passage of genes within a species, but also incorporates the whole of the life-cycle and the different needs and pressures found between separate ages and sexes. By looking at the entire life history of individuals within a species we can increase our understanding of the mix of biology and behaviors that is adaptive and of the strategies individuals use to survive and ultimately pass on their genes (Morbeck, 1997).

By studying the effects of biology, environmental pressures, and the strategies individuals develop to adapt and survive, we can better understand which traits were likely to be passed down through evolution. Our hominin ancestors (like ourselves and fellow primate species) were intelligent and complex individuals who not only received specific traits at birth, but also developed strategies to maximize their ability to cope with biological and ecological demands. In an article in the book *The Evolving Female*, Zihlman asserted that we should:

...consider sex differences in the context of what each sex has to do to survive and reproduce throughout the life course. The integration of survival with reproductive life-history characters gives a more complete picture of adaptation and possible mechanisms for evolutionary change (103, 1997).

Answering Zihlman's call to address sex differences and reproductive roles I will examine the differences in time-allocation and energy expenditures between male and female apes and humans. All female primates, but specifically Old World monkeys and apes, are the primary caregivers of their young. The routines of females change greatly during their life span in response to their reproductive roles. This shift in schedule is far more pronounced than those which are spurred by the life changes seen in males. As I highlight these shifts across different ape species, the strategies females use to overcome the increased time and energy demands of their slow-developing infants will also be illustrated. Ultimately, I will relate how these strategies shifted in the course of human evolution as our ancestors adapted to changing physiology and environment. I will illustrate how the changes in hominin lifeways, particularly the reproductive adaptations that developed in response, could have led to the invention of the first human-specific tools, such as slings and baskets. Finally, I will describe how the reproductive strategies of our female ancestors, which were structured around how to protect, provide for, and successfully raise a productive member of the next generation, could have contributed to the evolution of our species and the development of civilization as we know it.

Nonhuman Primate Females' Time, Energy, and Reproductive Strategies

In many nonhuman primate species females need to allocate more time and energy to food gathering as compared to males. This produces more pressure for them (than for males) to create and utilize those tools and strategies which will help them better gain energy from their environment. I will first examine the time budgets of chimpanzees and bonobos and the possible reasons for variability between them. The greater proficiency in tool use by females in several different primate groups can be seen as an extension of the flexible strategies utilized by them to successfully raise their young and meet their own needs while conserving energy.

Robust chimpanzees

Robust chimpanzees are the most often used template for human evolution. This is largely due to the fact that they are one of our closest relatives. They are the most extensively studied of all the great apes, and they exhibit behaviors, such as tool making and hunting, that were at first assumed to be specific to humans beings (Zihlman, 1997). As I will demonstrate, the differences in energy expenditures between male and female chimpanzees create strikingly different reproductive strategies, particularly in the utilization and production of tools which are used to more efficiently extract energy from the environment.

Robust chimpanzees are less sexually dimorphic than orangutans and gorillas. On average, females weigh about 75% and 85% of the male weight (Zihlman, 1997). Chimpanzees live in multimale-multifemale fission/fusion groups of between 30 and 80 individuals that separate into smaller groups of differing composition to forage. They eat a wide variety of foods, which include leaves and meat, but their diet primarily consists of fruit (Napier, 1985).

There are differences in the overall range and distance traveled between males and females. Females in all known chimpanzee populations have smaller daily ranges than males. There are also differences in range for females over the reproductive cycle. Cycling females have larger daily ranges than females in the later stages of pregnancy and those in the first few weeks postpartum. In general, females with young have smaller ranges than those without. It is also thought that female chimpanzees only forage alone or with immediate family members in order to decrease competition for food and reduce the amount of time they spend in social interactions, thus conserving energy (Zihlman, 1997). While feeding, females in the Tai forest also conserve energy by moving around more quadrupedally and moving less. Males, on the other hand, are more bipedal than females and climb and scramble more (Zihlman, 1997).

The tool use differences among males and females are one of the most striking characteristics of chimpanzee behavior. It has been observed that females in Gombe spend more time than males constructing and utilizing tools to extract termites from their mounds (Zihlman, 1997). Among the Tai Forest chimpanzees, females employ the stone and wooden implements used for cracking nuts more frequently and with greater skill than do males (Zihlman, 1997; Boesche and Boesche-Ackerman, 2000). In all known chimpanzee populations, females use tools for feeding with greater frequency than males (McGrew, 1981). At Mahale, females engage in catching prey more often than those in Gombe. In all populations males more often and more actively pursue prey than females (Zihlman, 1997).

However, the new findings in Senegal among the savanna chimpanzees could shed light on sex differences in predatory behavior and tool use. The females' greater tendency to fashion and utilize spears in order to hunt small mammalian prey is still qualitatively different from the male chimpanzees more active pursuit of prey. Hunting sleeping prey with spears is much more energy conserving than running after prey animals, which are actively avoiding being caught. It is also safer, because there is less chance of falling (males often chase their prey up into tall trees) and of prey group retaliation, particularly since bushbabies are solitary animals. I believe that further observation will reveal that, much like other instances of tool use across the other chimpanzee groups, female savanna chimpanzees in Senegal use tools for hunting prey with greater efficiency and frequency than males.

There are consistent differences in sociality between male and female chimpanzees and regional differences in sociality within chimpanzee groups. Females in all known chimpanzee populations transfer to other groups at adolescence; they also sometimes transfer while cycling. Females with young, however, remain in their groups. Gombe females are less social and more solitary than the males. They tend to prefer the company of their immediate family and do not socialize much with other adult females (Zihlman, 1997). However, there is some variation in this pattern between groups. Tai Forest females are more social than females in other studied populations; they share food and develop alliances (Hawkes, O'Connell, & Blurton Jones, 1997). This greater cohesion has been tied to increased predation from leopards. However, in all populations males are more social than females (Zihlman, 1997).

Female chimpanzees are a striking example of energy conservation and innovation. They innovate more at tool use and in those tasks which help them to more efficiently gain energy from the environment. Females are more cautious and have smaller ranges than males, which makes their lives more predictable, safer, and also helps them to conserve energy. Yet though females are conserving energy they are still quite actively engaged in attending to and socializing with active and curious young, usually more than one. This devotion often creates a high degree of loyalty from their adult young as well (Goodall, 1990) and serves to cement the bonds of siblings, particularly when the mothers are competent and attentive, even after their mother's death (Goodall, 1990). Females are not doing less than males; they simply have a different focus. Much of their time and energy is taken up by the day-to-day needs of their young as well as the necessity to raise competent and successful adults. This requires socialization, affection, conservation, and innovations that make the rest of a mother's life a little easier.

Bonobos

Even though bonobos are almost genetically the same species as robust chimpanzees, their behavior is very different. Unlike chimpanzees, they do not fission during foraging, they share food much more often, and females are dominant in most interactions with males. These differences in foraging and sociality create a very different picture of life for females in bonobo groups and may put less impetus on females to find innovative methods to extract energy from the environment.

With bonobos, there is a difference in body weight comparable to that of robust chimpanzees, but there is very little difference in canine size and no difference in cranial capacity (Zihlman, 1997). Thus females' brain-to-body size ratio compared to males is larger than that found in robust chimpanzees.

Bonobos groups travel together and females are the dominant sex. Like robust chimpanzees, however, females do transfer to other groups at adolescence. Unlike the other species, though, when they enter a new group they immediately bond with the dominant female by genital rubbing and grooming. Females form close social ties with each other, whereas males only tend to bond closely with females. There is a great deal of food sharing between all members of the group (less between males), and the entire group bonds through sexual contact. In general, bonobos tend to be much less aggressive than robust chimpanzees (Zihlman, 1997).

This difference in social behavior creates a very different environment for females. There is very little difference between the sexes in terms of foraging and range. This similarity mostly has to do with the fact that the group (or large subgroups) moves together and shares food so regularly that an almost equal amount of time is spent foraging. However, males do scramble, climb, and leap more than females, thus requiring greater expenditures of energy (Zihlman, 1997). This difference in climbing activity cannot be explained by size difference, since males are larger than females. Also, since males typically only share with females and females share with females, perhaps there are more resources funneled toward the females than is realized.

Recent findings have also revealed that bonobos also use tools and complex strategies in the wild. They use leaf sponges to carry water with them, leaf whisks to swat away flies, and members of one group may orient vegetation to indicate the direction they have gone to another group (Susi, 2006). However, the sex differences in these activities have not been studied as thoroughly as tool use has in robust chimpanzee populations. This is largely due to their critically endangered status, which makes them difficult to locate, and the fact that researchers have only relatively recently begun studying this species.

It appears that despite some instances of tool use by females of both species, overall robust chimpanzee females tend to use and innovate more on those tools that more efficiently extract energy from the environment. Why is this? I believe this is because bonobo females can gain the food they need more easily through food sharing than robust chimpanzees. This freer exchange of resources creates less pressure for bonobo females to innovate. It is not that they can not innovate or use tools, a point that has been dramatically demonstrated in captivity and psychological research (Visalberghi, Savage-Rumbaugh, & Fragaszy, 1995); it's that they have less need to. Perhaps bonobo females have discovered alternative reproductive strategies, such as food sharing and female dominance, which compensate for their more energetically demanding reproductive roles. However, there is still the chance that further observations of this rare ape will reveal tool

using sex differences similar to those of chimpanzees.

Bridging the Gap between Apes and Human Evolution

I have demonstrated how female non-human primates during different stages of their reproductive cycles allocate their expenditures of time and energy in a variety of ways as well as how their strategies differ, overall, from males. In this way, female humans are no different than their ape counterparts. As mentioned in the introduction, the lives of modern foragers (or hunter-gatherers) are also commonly used as templates for human evolution and the lifeways of females in foraging societies greatly differ from those of males. Modern foragers subsist directly from their environment and there are a few parallels between different foraging societies. All hunter-gatherers share food and have a division of labor. Though the specific arrangements of that division differ from group to group, in general males do more big game hunting and range out farther than females. Females gather plants, eggs, insects, honey, and small burrowing animals in all foraging groups. They can hunt, and in some societies often do, but specific excursions for the purpose of hunting usually occur before they have their first child or after their children are old enough to look after themselves (Estioko-Griffin & Griffin, 1981).

There are many similarities in the lifeways of modern foragers and those of bonobos and robust chimpanzees. Similar to robust chimpanzees, females in foraging societies have smaller ranges and they participate much less in big game hunting, particularly going out on excursions specifically to find game. This indicates that there are similar pressures felt by human females in these societies to conserve energy as well as reduce the risk of injury from behaviors like hunting large animals and moving too far from known territory. In addition, like chimpanzees, modern foragers do fission into smaller groups while foraging, but foraging often does not take up the majority of the day. Unlike robust chimpanzees, however, the group comes together after foraging to share food and experiences. Human females also diverge from robust chimpanzees because they are not less socially active than males. In fact, much research has pointed to exactly the opposite conclusion. Even in modern industrialized societies, females socialize more and tend to be the social glue of their family and friends. They also score higher than males on all tests of verbal skills (Mitchell, 1979). Verbal ability is a skill that can only be utilized and refined through sociality. These higher test scores in females point to their tendency to use language to communicate in complex ways. I believe that this trend did not just appear, but that it evolved as a necessary survival strategy of females which most likely began long before we took our first bipedal steps out of the dense rainforest. If so, bonobo sociality would be the most probable template of early hominin social interactions. Having these social tendencies before our ancestors began to subsist exclusively in savannah and woodland habitats would have been much more advantageous than if they had first existed in fission/fusion groups with no food sharing.

Moving in larger groups together would have afforded much better protection from the many predators on the savannah who would have taken swift advantage of a lone member of our highly visible, bipedal ancestors. Whether our early hominin ancestors shared food is still up for debate, but if they had moved into the drier and more open areas with even occasional food sharing they would have had a better chance of survival. Later in our evolutionary history there is strong evidence of food sharing in the form of occupation sites and large middens, or prehistoric refuse heaps, in which our ancestors discarded their leftovers after bringing their gathered foods back to the camp and processing or eating them (Isaac, 1971). If our earliest ancestors had shared some foods even occasionally, it would have brought the group closer together and would have served as a template for the future forager model of food sharing.

However, I do believe that since the environment of the savannah and dry woodlands is and was less abundant in resources than the dense rainforest, that gregarious food sharing would have been more difficult for our ancestors than for bonobos. Plus, food sharing in foraging communities is relatively generalized, but there is a pattern of sharing first with close relatives such as between mothers and children, siblings, and other family members. I believe that generalized food sharing grew out of mother-infant sharing (Slocum, 1975) and it developed into what it is today by the hominin female's greater need to conserve energy and care for her young. In addition, the female's greater need to more efficiently gain energy from her environment and cope with the physiological challenges of bipedalism would have provided more pressure for females to develop strategies that would relieve this pressure. In this way, our ancestors more closely resembled robust chimpanzees, because of the greater environmental pressure placed on females. I believe some of the first tools invented by our hominin ancestors were most likely invented by females in order to care for their young and themselves.

The Evolution of Tool Use

Increased Energetic Demands

So what created the greater pressure on human females in the first place? Why was there so much pressure on mothers that they needed to enlist the help of others? I believe the answer to that lies in the different ecological pressures faced by our ancestors out in the drier savannahs and woodlands than those faced by apes.

Whatever mechanism initially spurred us to move about on two legs, the adoption of the bipedal posture had an enormous impact on the physiology of our ancestors. It particularly impacted early hominin females and thus increased their work. Just the skeletal and musculature changes caused by moving to a bipedal posture had an enormous impact on the life histories of females. Compared to other primates, human beings have proportionately enormous lower limbs and relatively much weaker upper limbs. This meant that our weight was reallocated to the bottom of two limbs which caused our feet to become rigid support structures rather than the more versatile grasping feet of all other apes (Zihlman, 1997). What did this mean for females? It meant that when babies were born, they no longer had the strong upper limbs with which to grasp on tightly to their mothers. Their rigid feet were also no longer as adept at grasping. Even if early hominins had opposable big toes, retained body hair, and were not born any more premature than the infants of other apes, it would have been much harder for infants to grasp onto their mothers with these rigid feet and weak arms. This increased pressure on hominin females because they now had to actively hold on to their infants, which limited the amount they could forage at one time. In addition, they had to care for themselves and their long dependent young while living on the drier and sparser landscape of the savannah and avoiding predators. In addition, the vertical orientation of bipedalism caused the pelvis to become the central balancing point of the body from which the legs, which were closer together, had to be attached and in which the organs had to be supported. This caused the opening in the pelvis to become smaller to adapt to these new demands, which made birth much more difficult for females (Zihlman, 1997). This made childbirth a much more life threatening and energy consuming affair.

This greater consumption of energy cannot only be inferred from the fossil evidence, it can also be seen in the differing percentages of fat between female humans and other Old World primate females. Approximately 13% of a female macaque's body weight is made up of adipose tissue. In males, only 9% of their bodies are made up of fat. These distributions of fat do not change much among the apes. However, among humans, female bodies are more than 25% fat and male bodies are only 14%. Male humans follow the pattern of fat distribution more typical of primates. So why do women need all of this fat? Fat is just stored energy and female humans need that energy for gestation, birth, lactation, the infant's and child's long period of dependence, and all the work that goes with that (Zihlman, 1997).

Tools for Decreasing Pressures and Gaining Energy

So how did our ancestors deal with these obstacles? There was a great deal of pressure put on females to take care of their young who now needed more support from their bipedal mothers as they walked around and foraged. While bipedalism freed our hands for foraging, it also required that a mother carry her young with one hand while trying to attend to her needs with the other. This limited the amount she could carry at one time and increased the energy expended on each foraging trip. Of course, all of this was added to the fact that our bipedal ancestors live in more open and dry environments than their ape cousins. The resources they needed to gather were more widely scattered. They also needed to watch out for and, if possible, avoid or defend themselves from predators. Thus there were pressures on our female early hominin ancestors, who had brains that were relatively the same size as modern chimpanzees, which were quite different from the other apes (Zihlman, 1981). And of course, there was also the similar pressures experienced by all ape mothers, hominin mothers still did all of the child care and carried and nursed their young constantly for 3 to 4 years (Ward, 2006).

The creation and utilization of these life sustaining tools most likely would not have deterred from the overall primate pattern. All chimpanzee females utilize tools for gathering foods at a greater degree and more efficiently than males (McGraw, 1981), because of their greater need. There is no reason to believe, as many proponents of *Man the Hunter* do, that our human ancestors were completely unique in that males created all practical tools and weapons and females simply sat back and raised the children. Nor is there reason to believe that all modern foragers are completely different from their hominin ancestors. This is best illustrated by what Hart and Sussman stated in *Man the Hunted*:

Among modern human hunter-gatherer cultures, most tools, again, are used not

for hunting large prey but rather for gathering plants, eggs, honey, small insects, and small burrowing animals. Women's tools include digging sticks, poles for knocking down fruit or nuts, and rocks for cracking nuts or tough fruit rinds. Containers can be tools also: baskets and slings are used for carrying babies and gathering roots, nuts, berries, and grains. And, again, most of these tools *are made and used by women*, not men (Hart & Sussman, 2005: 215).

Therefore, I think it is justified to assert that most tools for the purpose of more efficiently gathering and caring for young were almost certainly invented and more rigorously utilized by women throughout our evolution.

Due to their vertical orientation and the physical demands that grew from it, many have postulated that the first tools created by our hominin ancestors were invented to help mothers carry their offspring. Slings, baskets, bags, and nets found in all foraging societies were probably first invented by our female hominin ancestors to help them transport their infants (Slocum, 1975; Ward, 2006; Zihlman, 1981). Among modern foragers, slings for carrying babies can be multipurpose tools. Among the !Kung San foragers of the Kalahari Desert in South Africa, women carry both their infants and their gathered goods in the same sling. Indeed, these are highly versatile devices that give infants continuous access to the mother's breast and free both of the mother's hands for foraging (Konner, 1976). I imagine that the first slings to carry babies resembled these simple, but highly practical tools. Based on the evidence, I assert that due to their *need*, which was not a pressure males would have felt, females in all probability were the first to invent slings or nets to carry their offspring as well as containers to carry back their gathered food items, which I believe developed out of the first inventions for carrying young. Since males were not the primary caretakers of the young, they would have had less of a need to invent such tools to reduce the amount of energy required to care for young.

Containers were not the only tools created by our female hominin ancestors. Digging sticks are another tool that many believe were invented by females to help them more efficiently gain energy from the environment (Ehrenberg, 2001). Not only do women in modern foraging societies make and utilize these tools more than men (Hart & Sussman, 2005), but the creation and primary usage of these tools by hominin females would have followed the overall primate pattern. As I have mentioned, chimpanzee females in all known groups use tools for procuring food to a greater degree and with greater efficiency than males (McGraw, 1981). Digging sticks in modern foraging societies are used for digging up tubers which are buried under the ground and are often too difficult to get to with hands alone. Among the Hadza foragers of Tanzania, the tubers extracted with digging sticks are consistent staples that can be attained year round (Hawkes, O'Connell, & Blurton Jones, 1997). Wooden digging sticks have been found in association with australopithecine fossils and were one of the first tools that we know our hominin ancestors utilized to obtain underground tubers and rhizomes (Ragir, 2000). Exploiting this difficult to obtain resource would have opened up a whole new supply of nutrients on the dry savannah and would have become an important staple in times of scarcity. Therefore, I contend that, much like chimpanzees and modern foragers, our female hominin ancestors utilized these tools for extracting nutrients from the environment more often than males. They would have created these tools because of their greater need to develop innovative strategies to decrease environmental and physiological pressures in order to better care for themselves and their young.

Conclusion

Just as in chimpanzee and human foraging societies today, I believe that our female ancestors played the major role in the creation and utilization of life-sustaining tools. Digging sticks and carrying tools make a female's life easier and decrease the amount of energy she has to expend to care for herself and her young. I assert that it was the female who invented the first tools and this eventually spurred the creation of the first widespread food sharing. Without the sling and digging stick, humanity as we know it would not exist. We could not have extracted tubers and other roots, which were an

abundant and consistent resource base. Without these resources, we might not have been able to expand into more marginal territories or have reliably fed ourselves during times of scarcity. Without the creation of containers, how could females have carried and properly provided for their young and themselves? In addition, without containers to carry back gathered goods, food sharing would have been almost impossible and we could not have provisioned weaned children. In the absence of the tools that made life easier and helped us more efficiently exploit our environment, how could we have become as cohesive and organized as we are today? So many things that make us human are wrapped up in the pressures that intelligent female primates had to deal with and their efforts to overcome them.

Acknowledgment

I would like to thank Dr. Kimberly Baldus for her aid in preparing this article for publication. I appreciate her encouragement and honesty as well as her incredibly thorough critiques. I would also like to express appreciation to my mentor, Dr. Donna Hart, for her enthusiastic involvement in my academic career these past few years as well as her continuing interest in my research pursuits and graduate applications. It was in her classes that I discovered my love for primates and for human evolution.

About the Author

I received two Bachelor of Arts degrees in Anthropology and Psychology in May 2007. Since that time I have been exploring graduate programs in Anthropology and obtained a month of research experience by observing the sex differences in feeding ecology among howler monkeys in Costa Rica. I am currently working on a research project concerning sex differences in tool and object use among the chimpanzees at the St. Louis Zoo. I am very interested in our primate relatives and human evolution, particularly the evolution of the division of labor, food sharing, reproductive ecology, and the development of tool and object use.

References

- Boesch, C., & Boesch-Acherman, H. 2000. *The chimpanzees of the Tai Forest: behavioral ecology and evolution*. Oxford University Press: Oxford, UK.
- Bramblett, C. A. 1994. *Patterns of primate behavior*, 2nd edition. Waveland Press, Inc.: Illinois.
- Ehrenberg, M. 2001. The role of women in human evolution. In: *Gender in Cross-Cultural Perspective*, 3rd edition. Brettell, C. B. and Sargent, C. F., editors. Prentice Hall: Upper Saddle River, NJ. pp 17-22.
- Estioko-Griffin, A. & Griffin, P. B. Woman the hunter: The Agta. In: *Woman the Gatherer*. Dahlberg, F., editor. Yale University Press: New Haven. pp. 121-152.
- Fedigan, L. M. 1986. The changing role of women in models of human evolution. *Annual Review of Anthropology* 15, 25-66.
- Goodall, J. 1990. *Through a window: my thirty years with the chimpanzees of Gombe*. Soko Publications Ltd.: London.
- Hart, D. and Sussman, R. W. 2005. *Man the hunted: primates, predators, and human evolution*. Westview Press: New York.
- Hawkes, K., O'Connell, J. F., & Blurton Jones, N. G. 1997. Hadza women's time allocation, offspring provisioning, and the evolution of long postmenopausal life spans. *Current Anthropology* 38(4), 551-577.
- Konner, M. 1976. Maternal care, infant behavior and development among the !Kung. In: *Kalahari Hunter-Gatherers : Studies of the !Kung San and Their Neighbors*. Lee, R. B. and DeVore, I. (eds). Harvard University Press: Cambridge, MS.
- Leacock, E. 1992. Women's status in egalitarian society: Implications for social evolution. *Current Anthropology* 33(Supp.), 225-259.
- Leibowitz, L. 1993. Perspectives on the evolution of sex differences. In: *Gender in Cross-cultural Perspective*. Brettell, C. B. and Sargent, C. F., editors. Prentice Hall, New Jersey.
- Linton, S. 1975. Woman the Gatherer: Male Bias in Anthropology. In: *Women in Cross- Cultural Perspective: A Preliminary Sourcebook*, Jacob, S. E. (ed). University of Illinois Press: Champaign, IL. pp. 9-21.
- McGrew, W. C. 1981. The female chimpanzee as a human evolutionary prototype. In: *Woman the Gatherer*. Dahlberg, F., editor. Yale University Press: New Haven.
- Mitchel, G. 1979. *Behavioral sex differences in nonhuman primates*. Van Nostrand Reinhold Company: New York, NY.
- Napier, J.R. & Napier, P.H. 1985. *The natural history of the primates*. The MIT Press: Cambridge, MS.
- Pruetz, J. D. & Bertolani, P. 2007. Savanna chimpanzees, Pan troglodytes verus, hunt with tools. *Current Biology* 17, 412-417.
- Ragir, S. 2000. Diet and food preparation: rethinking early hominid behavior. *Evolutionary Anthropology* 9(4), 153-155.
- Slocum, S. 1975. Woman the gatherer: male bias in anthropology. In: *Toward an Anthropology of Women*. Reiter, R.R., editor. Monthly Review Press. pp. 36-50.
- Susi, T. 2006. *The puzzle of social activity: the significance of tools in cognition and cooperation*. Ph.D. dissertation, Linköping University, Sweden.
- Sussman, R. W. 1999. The myth of man the hunter, man the killer and the evolution of human morality. *Zygon: Journal of Religion & Science* 34(3), 453.
- Ward, M. C. 2006. A world full of women. In: *Annual Editions: Anthropology*. Angeloni, E., editor. McGraw-Hill/Dushkin, Iowa. pp. 118-126.

Washburn, S. L. and Lancaster, C. S. 1968. The evolution of hunting. In: *Man the Hunter*. Lee, R. B., De Vore, I., Nash-Mitchell, J. editors. Aldine De Gruyter, New York.

Weiss, R. 2007. The first time, chimps seen making weapons for hunting. *Washington Post*, Feb. 23, A01.

Visalberghi, E., Savage-Rumbaugh, G., and Fragaszy, D.M. 1995. Performance in a tool- using task by common chimpanzees (*Pan troglodytes*), bonobos (*Pan paniscus*), an orangutan (*Pongo pygmaeus*), and capuchin monkeys (*Cebus apella*). *Journal of Comparative Psychology* 109(1), 52-60.

Zihlman, A. L. 1978. Women in evolution, part II: Subsistence and social organization among early hominids. *Signs* 4(1), 4-20.

Zihlman, A. L. 1981. Women as shapers of the human adaptation. In: *Woman the Gatherer*. Dahlberg, F., editor. Yale University Press: New Haven. pp 75-120.

Zihlman, A.L. 1997. Natural history of apes: life-history features in females and males. In: *The Evolving Females: A Life-History Perspective*. Morbeck, M. E., Galloway, A., and Zihlman, A. L., editors. Princeton University Press: Princeton, NJ. pp. 86-104.

Zihlman, A. L. 1997. Women's bodies, women's lives: an evolutionary perspective. In: *The Evolving Females: A Life-History Perspective*. Morbeck, M. E., Galloway, A., and Zihlman, A. L., editors. Princeton University Press: Princeton, NJ. pp. 198-208.

Lethbridge Undergraduate Research Journal
ISSN 1718-8482