BIRTH AND THE BIG BAD WOLF: AN EVOLUTIONARY PERSPECTIVE

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BIRTH AND THE BIG BAD WOLF: AN EVOLUTIONARY PERSPECTIVE**[i]**

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Once upon a time, there were six little pigs who set out to seek their fortunes in the world (okay, we know that in the original story there were only three, but just bear with us here!). Far away from home they journeyed, until the first little pig spied a peaceful meadow with a stream running through it; there he stopped his hot and weary journey. In two hours he had built himself a house of straw, then he spent another hour building animal traps, after which he set about to laugh and dance and play all day. It was like that every day — he would spend three to five hours hunting wild game, after which he could do as he pleased. The female pigs gathered wild grains, tubers and fruits so that food was available even when the hunt failed. Although the first little pig didn't always like to admit it, the female pigs brought in 70%-80% of the diet from foraging, and often helped with the hunting and trapping as well. He was feeling very content, for he had wished to find an environment that could sustain him and his small band of kin pigs, and he had. Sure, he and his like-minded friends experienced high infant mortality rates and a resulting life expectancy of around 35 years, as well as high death rates from endemic disease and accidental death. However, as they discussed frequently in their abundant leisure time (in between the long stories they loved to tell), these problems were offset by their varied and nutritious diets and high mobility, which made sanitation and infectious disease transmission non-issues. Life was good and gender relationships egalitarian for the most part

The first little pig and his kith and kin were so successful at their hunting and gathering that after a couple hundred thousand years, they had overpopulated the most fertile areas of the world. Under pressure to feed so many mouths, necessity (the mother of all invention) was combined with the knowledge of plant life cycles developed during the days of gathering to create a new subsistence strategy–horticulture. The second little pig and his matriline began to fell trees and to plant gardens, and for the first time in human history, planted foods to supplement those that were foraged. The work was harder and longer — it took five to six hours a day — but still they had plenty of leisure time for singing, dancing, and storytelling. The females did most of the work anyway, planting, cultivating, harvesting and processing the food they grew, and chopping wood and carrying water, while the males spent their time hunting and performing the rituals that assured them that all was, and would remain, as it should be. They built their houses of sticks because they were still semi-nomadic, moving their villages every five years as garden soil and large game populations were exhausted. This kept life interesting. The diet was highly varied and population densities low enough to keep infectious disease in check, and while the seeds of gender inequality were sown along with the first domesticated plants, for the most part, life was good for the horticultural pigs.

The third little pig was horrified at his brothers' lack of industriousness. He knew the danger they were in from the big bad wolf, and that silly little houses of straw and sticks stood no chance should the wolf try to huff and puff and blow them down. So he went much farther down the road and through the millennia, away from the wolf's territory, until he found a nice flat field good for planting, near a large river from which he could divert water for irrigation. He set to work building himself a sturdy house of wood and stone that the wolf could not blow down. It took him weeks of hard labor, working eight to ten hours a day to build the house, and then more weeks to dig the irrigation canals and plant his large field. He knew that his lazy hunter-gatherer and horticulturalist brothers would soon be coming to him for shelter and food, and he, the industrious agriculturalist, planned to be prepared. The third little pig and his friends enjoyed increased population densities as more of them settled down and committed to growing their food. Yes, there was less variability in what they had to eat, and food production was extraordinarily labor intensive, but with the availability of safe weaning foods, female pigs could nurse for shorter periods of time allowing for a return to fertility and shorter interbirth intervals so more little pigs could be born to

*work the fields and build the communities. Standing water from irrigation ended up being a pesky vector for mosquito-borne diseases like malaria, and sanitation and acute crowd infections became an issue, but agriculturalist pigs could also acquire possessions, own land and rise to the tops of social hierarchies, especially where female pig production and reproduction could be exploited. He was sure that he was much safer from the big bad wolf than his brother pigs who were still living in the forests, the jungles, and the wild fields where danger roamed.**[ii]** Life was good, although without much leisure, the third little pig didn't have as much time to enjoy it.*

The fourth little pig watched with resentment as intensive agriculture took over the most fertile land, and foraging and small-scale horticulture became marginalized. His desire to roam and explore new lands was the hunting-gathering legacy of wanderlust, and he had no desire to settle down. He gathered up his goat hair tent and began herding animals through agricultural territory, exploiting high hills, low valleys, the wild Northern steppes and the plains of Africa, developing humankind's fourth subsistence strategy — pastoralism — and enjoying his freedom. Because male pigs tended to own, care for and manage the herds, and because they often had to fight for rights of passage through agricultural lands, pastoral warrior cultures developed that functioned to enhance male pig power. Their domination of herding tended to be reflected in other aspects of social organization – including the near universality of patrilineal decent, patrilocal residence patterns and segregation of the sexes. Life was good for the male chauvinist pigs, but symbolic and social stratification by gender spelled trouble for females, especially where strict honor codes and the exchange of women as chattel challenged girl-pig autonomy.

The fifth little pig, watching the dependence of his brothers and sisters on nature and knowing its dangers, was sure he could improve on matters. Farming could be industrialized, and by moving into cities and building large tenements made of bricks that could sustain huge populations densities, a work force would be available to modify the fruits of agricultural labor into value-added products for sale under a capitalistic economic system. Yes, some exploitation of pig children and recent pig immigrants would be necessary and infectious disease rates would rise, especially where sanitation and food quality was poor, but the fifth little pig could also amass huge stores of material wealth because he owned the means of production. With eventual improvements in sanitation, basic public health interventions and an intentional decrease in family size as children became more expensive to raise, life expectancy would rise, providing a long lifetime over which to feel the intense need to buy the products produced in factories with innovative technologies and machinery. The fear of the big bad wolf would become a distant memory thanks to habitat destruction and the increasing distance of settlements from unmodified landscapes. Life was good for the fifth little pig and his industrializing friends, especially when they could exploit natural resources and a cheap labor force in the other pigs' homelands.

*The sixth little pig was so far removed from nature that he lost all sense of its value and devoted himself to inventing complex technologies, building gleaming cities of glass and concrete, paving over all things green and putting as many products as possible into elaborate plastic wrappers with widely identifiable logos and branding. He developed a technocratic society**[iii]** organized around an ideology of progress through the development of high technology and the global flow of information. Beginning just a few decades ago, the forces of globalization, consumerism and neocolonialism transformed even the most remote agriculturalists into dependents in an exploitative, global economy that produces vast inequities between high and low-income nations. The sixth little pig and a few of his elite investor friends benefited, while many others struggled to access even the most basic of resources. Soon environmentalist pigs began to notice that the nature that they had worked so hard to tame through technology was turning on them as industrialization heated the planet, melted the glaciers, and polluted the atmosphere. The sixth little pig started to wonder whether he and his industrialist brother had gone too far.*

And sure enough, as we all know, the big bad wolf (who escaped from a zoo rehabilitation program) did in fact show up, and he huffed, and he puffed, and he blew down the houses of the little pigs, who all came racing over to the house of their technocratic brother, who let them in and slammed the door just in time! In the end, they were safe in the sixth little pig's McMansion where the big bad wolf could not harm them. But the first five little pigs were unhappy with the eighty-hour work week, lack of medical insurance and rampant consumerism, perceived needs and massive debt that the technocracy had to offer. They were frustrated by the lower status that was culturally assigned to them because of their "uncivilized" pasts. They felt uncomfortable in the air-conditioned home with the zero lot line, and missed the sounds of the wind in the trees. The first five little pigs became medical anthropologists and began to reflect on what had been lost when modernization became the primary goal during the Industrial Era. They realized with regret that the big bad wolf was nothing more than a

metaphor for the wild, uncontrollable and chaotic natural world that pigs had been attempting to tame through culture. They didn't want to give up their cars, computers, and cell phones, but they did wonder…perhaps there was a lesson to be learned from the story of the big bad wolf?

Folktales often condense millennia of historical events into one short story, and this one is no exception. From the time of our emergence as *Homo sapiens,* perhaps as long as 195,000 years ago (McDougall, Brown and Fleagle 2005, White et al. 2003), we have lived as hunter-gatherers, picking fruit from trees, foraging wild grains, digging for vegetables, and hunting animals both large and small. The power of our own experiences, "living in the now", and the effects of socialization that make "normal" simply what we are used to, can obscure the fact that the technocratic society we know and reproduce in today accounts for less than 1% of human history (Table 1). Only 1-2% of our biological make-up has evolved since the ape-human split between five and seven million years ago, meaning that the vast majority of our genes are ancient in origin (Trevathan, Smith and McKenna 2008). There have been a few simple genetic changes since the third little pig and his wife invented agriculture around 10-12,000 years ago,[iv] but the pace of cultural evolution is generally much faster than biological evolution. As a result, humans today occupy 35,000-year-old model bodies that are not particularly well adapted to the technocratic and industrializing cultures many of us live in (Armelagos, Brown, and Turner 2005; Eaton, Eaton III, and Cordain 2002).

Subsistence Strategy	**Emergence (years before present)**
Hunting/Gathering	**>100,000**
(99% of human history)	
Horticulture	**12,000**
Agriculture	**10,000**
Pastoralism	**8,000**
Industrialism	**250**
Technocracy	**40**

Table 1. Human Subsistence Pattern Timeline.

One of the primary contributions of evolutionary approaches in anthropology has been to remind us that *Homo sapiens* today still live in Paleolithic bodies adapted for the stressors faced by the first little pig. Current diet, lifestyle and reproductive patterns are drastically different from those that produced the selective pressure under which humans and human childbirth evolved. This mismatch in genes and culture promotes, accelerates and fosters certain diseases, especially those associated with changes in diet, reduced exercise levels and excessively interventive and mechanistic approaches to childbirth (Cheyney 2003, 2005; Trevathan, Smith, McKenna 1999, 2008). The notion that discontinuities between the conditions under which humans evolved and the conditions we live in today produce dis-ease is called the "discordance hypothesis", and it forms the foundation for a relatively new subfield of Medical Anthropology called Evolutionary or Darwinian Medicine. This approach examines health conditions generated by the discordance between evolved biology and current culture and attempts to propose evolutionarily sound solutions or treatments (Stearns, Nesse and Haig 2008; Trevathan, Smith and McKenna 1999, 2008; Williams and Nesse 1991).

In this chapter, we discuss not the diversity in the ways childbirth is treated or culturally elaborated around the world as highlighted in the rest of this volume, but instead, we focus our attentions on the biocultural features that unite *Homo sapiens* as a species. We review what we see as remarkable similarities in human birth mechanisms and cultural practices over time and argue that, pre-Industrial Revolution, these similarities were an outgrowth of our common evolutionary heritage as bipedal primates. With industrialization, there emerged a fear-based need to control nature that, along with the hegemony of biomedicine, again produced relatively uniform cross-cultural birthing practices, though the latter differ significantly from premodern norms. We examine this shift in the cultural

elaboration of birth at the onset of the Industrial Era and discuss three areas where current obstetric approaches can benefit from holistic, cross-cultural and evolutionary perspectives. Our approach is co-evolutionary, meaning that we focus on dual-inheritance, or the identification of relationships between evolutionary biology and culture (Hewlett, De Silvestri, and Guglielmino 2002). We use "biocultural" and "co-evolutionary" throughout to emphasize the interactions between genes, culture, behavior and unequal relationships of power (Goodman and Leatherman 1998) that combine to produce the cross-cultural birthing patterns we see today.

THE BIOCULTURAL EVOLUTION OF MODERN HUMAN CHILDBIRTH

The unique anatomical characteristics of the human pelvis and the complex delivery mechanisms they necessitate have occupied the research agendas of numerous evolutionary biologists (Lovejoy 1988; Rosenberg 1992; Rosenberg and Trevathan 1996; Trevathan 1987, 1988, 1997, 1999; Trevathan and Rosenberg 2000; Washburn 1960) since anthropologist Wilton Krogman (1951) first referred to childbirth as a "scar of human evolution". The difficulty of human childbirth relative to other primates (Stoller 1995) is thought to stem primarily from the so-called "obstetrical dilemma" or the conflicting evolutionary pressures on human pelvic shape that necessitate a relatively wide yet flattened pelvis to optimize energetically efficient muscular attachments required for bipedalism (Lovejoy 1988) on the one hand, and an open, rounded and spacious passageway for the birth of relatively large-brained infants on the other. These competing selective pressures have resulted in an obstetrical compromise that requires the passage of a fetal head that is nearly the same size or larger than the maternal pelvis. As a consequence, human babies, unlike their primate relatives, must maneuver through a series of complex orientations, called the cardinal movements or mechanisms of labor, as they travel through the changing diameters of the birth canal during delivery (Trevathan 1987, 1988, 1997, 1999; Trevathan and Rosenberg 2000) (Figure 1). As a result, researchers, with few exceptions (Walrath 2003, 2006), have tended to see human birth as more painful and of longer duration relative to other mammals and to non-human primates, though for healthy mothers and babies, not necessarily more dangerous.

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Figure 1. Mechanisms or cardinal movements of human delivery in occiput anterior presentations (from Trevathan, Smith and Mckenna 1999: 196). PERMISSION requested from Oxford University Press

The comparatively difficult nature of parturition in our species has led researchers (Rosenberg 1992, 2003; Trevathan 1999) to hypothesize about the effects of our uniquely human obstetrical adaptations on changes in birthing behaviors and cultural norms over time. While non-human primates usually choose to give birth alone and under the cover of night, human mothers almost always seek out assistance from female relatives, friends and/or experienced birth attendants. Biological anthropologist Wenda Trevathan (1997, 1999) reasons that at some point in human history, the benefits of assisted birth would have outweighed the safety of solitary delivery. She finds support for this argument in the cross-cultural observation that very few societies idealize unassisted birth, and in those that do, solitary birth may only be expected of women who have already had one or more babies and/or in mothers with uncomplicated deliveries.[v]

This condition of "obligate midwifery", or the uniquely human need for an attendant, Trevathan (1997) argues, evolved in response to three important differences between the mechanisms of birth in humans relative to other primates. First, because human babies almost always emerge facing away from the mother (a position called occiput anterior), it is difficult for the mother to reach down, as non-human primates do, to catch the baby and to clear an airway or remove the umbilical cord from around the infant's neck (Figure 2). Secondly, modern humans give birth to secondarily altricial[vi] infants who require extensive care from the time of delivery. The relative helplessness of the human infant may be an additional reason why extra hands at a birth contribute to improved reproductive success, especially where mothers are exhausted by particularly long and difficult labors. Thirdly, Trevathan (1997) notes that powerful maternal emotions around labor and birth, including excitement, anxiety, fear, tension, joy and uncertainty, may have provided the evolutionary impetus for women to seek out support. The emotions of childbirth that encourage us to pursue assistance and companionship may be seen as biocultural adaptations to the physiological complications that result from bipedalism. Taken together, these three components of human birth may have contributed to the transformation of the process from a solitary to a

highly social enterprise, setting humans on a trajectory toward social and cultural interventions in birth (Trevathan 1997).

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Figure 2. Solitary, occiput posterior delivery in nonhuman primates (from Trevathan 1987: 91, Drawings by Bryan McCuller). Permission requested from Aldine de Gruyter.

THE CULTURAL ELABORATION OF CHILDBIRTH: BIOMEDICAL HEGEMONY AND THE TECHNOCRATIC MODEL

Enter culture… At some point in human history, perhaps around a million years ago with the appearance of large-brained *Homo erectus*, as Karen Rosenberg (1992, 2003) has proposed, human ancestors began to seek assistance, and in so doing, initiated the transformation of birth from a solitary, biological process to a biocultural and social one. As the chapters in this volume demonstrate, the nuances of each culturally constructed birthing system — the dietary taboos, the ideal direction to face during delivery, the rituals considered necessary for a successful birth, the first words whispered into the ears of newborn babes — are limitless in their variety. However, a broad, historical view makes far more visible what the birthing systems of hunter-gatherers, horticulturalists, pastoralists, and agriculturalists have in common. Up until the Industrial Age just 250 years ago, the essential cultural practices associated with childbirth were relatively uniform. Women all around the world moved freely during labor, changing positions frequently as a method for managing the pain associated with labor contractions and cervical dilation. They ate and drank as they pleased within the cultural confines of what was considered acceptable, nourishing and safe for the mother and baby. They were attended by other women whom they knew well, in a place that was familiar to them — usually in their home or in the home of a female relative. They labored and birthed in upright positions using instinctive knowledge to expand the size of the pelvis, capitalize on gravity, and to maximize the efficiency of the abdominal muscles needed for pushing (Figure 3). They developed artifacts like birthing stools and chairs, threw ropes over beams to pull against, birthed in flexible hammocks, and used poles for support in order to facilitate upright birth. Midwives knelt down in front of the upright mothers to receive their babies. Newborns were kept with their mothers for warmth, and long-term exclusive breastfeeding, co-sleeping, slings and other technologies kept baby and mother close during a year or more of external gestation (McKenna 2003; Montague 1971; Trevathan and McKenna 2003).

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Figure 3. Childbirth woodcut showing an upright birthing position in Europe during the Middle Ages (From When Midwifery Became the Male Physician's Province: The Sixteenth Century Handbook: The Rose Garden for Pregnant Women and Midwives by Eucharius Rosslin, 1513 (Rosslin and Arons 1994: 31). Book is out of print.

These basic cultural adaptations were normative until the huge social changes associated with industrialization moved birth from home to hospital and fundamentally changed the cultural face of birth, while doing little to reduce mortality and morbidity (Cassidy 2006; Wertz and Wertz [1977] 1989; Wilson 1996). In fact, it was the industrialization of birth, not birth itself, that gave women the fear of birth they have today (Cassidy 2006; Ulrich 1990; Wertz and Wertz 1989; Wilson 1995). Before the widespread acceptance of germ theory, the large, unsanitary lying-in hospitals of industrialized nations produced massive epidemics of puerperal or childbirth fever in the 18th, 19th and early 20th centuries (Crawford 1990; Leavitt 1986; Pollock 1990, 1997). Women died by the thousands in the lying-in hospitals of Europe and the United States until the germ theory of disease became accepted in the late 19th and early 20th centuries. As a result, massive precautions were taken in hospitals to prevent or decrease puerperal fever and other infections with a primary focus on attempts at sterilizing, standardizing and managing the birth process. Birthing mothers were painted from breasts to knees with orange iodine, forbidden to touch their own infants, and separated from them after birth, sometimes for days, even though more infections started (and still start) in nurseries than in babies kept with their mothers (Bertini et al. 2006; James et al. 2008; McDonald et al. 2007; Nguyen et al. 2007). Ritualized procedures like enemas and pubic shaving were instituted under the premise that they would prevent infections. It has taken decades of research to show definitively that such practices do not in fact decrease rates of infection; they were implemented

because of cultural categories and unfounded beliefs and are still common in developing countries (Cuervo, Rodriguez, and Delgado 2000; Baservi and Lavender 2001; Reveiz, Gaitan, and Cuervo 2007).

Over the last 40 years, the interventions that were introduced into the birthplace during industrialization have multiplied as societies like the United States have embraced high-tech, invasive solutions. As a result, much of our knowledge of unmedicated birth has been lost (Davis-Floyd 2001b). Physicians have been de-skilled and often no longer know how to attend normal deliveries patiently. After all, why learn how to attend a vaginal breech birth when a cesarean is so much easier (for the physician), and often more lucrative, to perform? As birth became more medicalized around the world, in most places, midwives lost their prestige as the guardians and guides at normal deliveries, becoming subordinated to physicians and trained out of traditional practices toward more industrial and technocratic approaches to birth.

Yet a midwifery revival is taking place — as more and more midwives realize what is being lost, they are working to regain their positions as the keepers and researchers of knowledge about physiologic birth, speaking and practicing outside the dominant paradigm, holding open a conceptual space where technocratic birth may be challenged (Cheyney 2008; Davis-Floyd 1992, 1997, 2001a, 2003, 2004; Davis-Floyd and Johnson 2006; Downe 2004). Biomedical hegemony, or the power-laden rule by cultural consent that constructs some models as authoritative (Jordan 1997) and others (like the midwifery models of care) as fringe, retrogressive and uncivilized, means that today, birth looks quite similar all over the world, yet quite different from the kind of births the wives of the first four little pigs would have experienced.

Today, as a result of the transformation of birth during the industrial and technocratic eras, women are not allowed to eat, drink, or walk around during labor. Dressed in hospital gowns and hooked up to intravenous lines that often carry pitocin[vii], prophylactic antibiotics and narcotics for pain, they give birth flat on their backs or in semi-sitting positions. The most notable differences in the contemporary medical treatment of birth have little to do with the specific customs of particular cultures, but instead, are more closely tied to the vast disparities between resource-rich and resource-poor countries. In most high-income nations, women receive significantly more interventions with pharmaceuticals and technologies applied at a higher rate, in more attractive and humane hospital settings. In most low-income nations, women receive less expensive and often outdated interventions like shaving, enemas, and episiotomies without the benefits of expensive interior decorating. In both rich and poor countries, cesarean rates are rising exponentially without a concomitant improvement in maternal and fetal health outcomes (Althabe et al. 2006; Wagner 2006). Cultural differences and traditions have been largely obscured by the highly influential and heavily standardized biomedical hospital procedures now common in almost all industrialized and industrializing nations.[viii] Technology has tamed the big bad wolf, damming, controlling and homogenizing the raw, elemental power of birth. However, the rapidly rising rates of iatrogenic morbidity, and in some places, the rising rates of perinatal and maternal mortality due to excessive obstetrical intervention (Betran et al. 2007, Liu et al. 2007, Villar et al. 2006, 2007) suggest that perhaps we have lost something in the process. What does the big bad wolf still have to teach us?

preModern Birthing Patterns and Why they Matter

Returning to the discordance hypothesis as applied to childbirth and the lens of Evolutionary Medicine, we have identified several areas where the conditions under which human childbirth evolved differ so substantially from the cultural norms enforced under technocratic models of birth that they require closer examination. Cross-cultural midwifery approaches, with their often-explicit rejection of the key components of the technocratic model, combined with their subversive application of time-honored behaviors and premodern traditions, provide an important point of comparison for critically examining contemporary, technocratic practices. The cross-cultural midwifery norms, for example, of encouraging movement in labor, upright pushing positions, the provision of intensive emotional support during labor, along with active encouragement of long-term breastfeeding and co-sleeping adaptive complexes are associated with significantly improved psychosocial and clinical outcomes for both mother and baby (McKenna, Mosko and Richard 1999; McKenna and McDade 2005).

We propose that midwifery and other low-tech, high-touch models of care that attempt to preserve “natural” (read those with a long history in human and non-human primates) birthing practices, produce the positive outcomes

documented in so many studies, because they reduce the discordance between evolutionary biology and recent culture. The do this via a mechanism that promotes working with, rather than against, the evolved biological and psychosocial needs of human mothers (Anderson and Murphy 1995; Durand 1992; Fullerton, Navarro, and Young 2007; Janssen, Holt, and Myers 1994; Janssen et al. 2002; Johnson and Daviss 2005; Murphy and Fullerton 1998; Rooks 1997; Schlenzka 1999). A closer examination of the premodern, reclaimed midwifery practices listed above, through the lens of Evolutionary Medicine, provides a clear, evidence-based template for the reform of contemporary, technocratic models of birth.

Unrestrained Movement in Labor Followed by Upright, "Physiologic" Pushing

Freedom of movement in labor used to be a cross-cultural norm, as it is in our closest living primate relatives, and the notion that women should lie in bed with their ability to self-comfort hindered by tubes and devices for fetal monitoring or intravenous fluid delivery is relatively recent and one that makes little sense from an evolutionary perspective (Trevathan 1999). There is a large body of clinical research that documents the value of upright postures and mobility during the first stage of labor (the stage where the cervix dilates) for speeding and easing the complicated descent through the pelvis that is unique to humans (Bodner-Adler et al. 2003; Gupta and Hofmeyr 2004; Gupta and Nikodem 2000). Upright postures maximize the dimensions of the pelvis, while improving blood flow to the baby by preventing compression of the large vessels that run along the mother's spine, supplying the uterus with oxygenated blood. Women who deliver outside the technocratic model with midwives or holistic physicians tend to labor and push in upright positions in accordance with the physiologic urges that come with an unmedicated second stage (the stage where the baby moves down through the birth canal and is born) (Cheyney 2005; Davis-Floyd et al. 2009). Epidural rates of close to 80% in U.S. hospitals (Declercq et al. 2006), however, prevent most women from utilizing the well-documented benefits of upright labor and pushing positions like squatting that optimize the curve of the human birth canal called the Curve of Carus (Figures 4 and 5).

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Figure 4. Changes in the Curve of Carus with Maternal Positioning (from Sutton and Scott 1996:55). This book is out of print.

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Figure 5. Homebirth mother reclaiming a premodern birthing position, assisted by midwives, assisted by the comforting effects of water made possible by the high-tech, hot tub (Photo by Peter Gonzalez).

Technocratic models of pushing rely instead on a technique called "laboring down," meaning that epidurally administered medications are stopped or slowed during pushing so that mothers can regain enough sensation to feel and follow the physiologic urge to push. However, because the numbing and temporarily paralyzing effects of spinal or epidural anesthesia take a variable time to recede, women often begin to feel the urge to push and yet cannot move freely to maximize their efforts. This means that most women who deliver under the technocratic model do so in a semi-sitting position with restricted movement. Many will, of course, still go on to birth vaginally. However, for those women with a tighter fit, the inability to move into more upright pushing positions, as well as the reduced ability to feel the urge to push, may mean the difference between a vaginal and a surgical delivery. Non-physiologic pushing, we argue, partially explains the high rates of cesarean delivery and associated maternal and neonatal morbidity that characterizes modern, technocratic obstetrics (Althabe et al. 2006). [Editor's note: See the chapter by Travis Harvey and Lila Buckley that suggests that fear of childbirth pain is the prime motivation for cesarean in Chinese women.]

Obligate Midwifery, Continuous Labor Support and the Avoidance of "Intimate Strangers"

The intimacy of time-intensive, continuous labor support provided by birth attendants who are a part of a woman's community or have come to know her well over the course of her pregnancy may play an additionally decisive role in how human birth unfolds. The calming presence of a familiar midwife or other companion may, for example, help to mitigate levels of stress hormones like cortisol and epinephrine that are known to inhibit the

effects of oxytocin — the hormone that stimulates labor contractions (Jolly 1999). The complex evolutionary relationships between hormones produced during fear and/or pain responses and those that stimulate labor combine to produce what have been called the “white coat” and “weekend” effects in humans and in non-human primates, respectively. These effects are characterized by the lessening or complete cessation of labor contractions when women and other primates feel afraid or anxious in response to being observed by doctors (“white coats”) and/or researchers. Where women experience a decrease in labor contractions in response to fear or uncertainty (compensated for in the hospital by the administration of pitocin), non-human primate mothers who live in captivity are often able to delay delivery until their attendants leave the holding facility (hence the “weekend” effect).

The release of adrenaline and cortisol in response to fear and stress, and the consequent slowing of labor, may have served an adaptive function in the past because such mechanisms prevent mammals — humans included — from delivering fragile infants under conditions of predatory danger. However, fears of pain, the hospital, specific procedures (like the placement of an IV catheter), or even just the feeling of self-consciousness that can come with laboring in front of “intimate strangers”, and the contraction-dampening effects of stress hormones are less beneficial in a technocratic environment where delivery must occur according to a relatively rigid time schedule to be considered “normal”. If human childbirth evolved under conditions of obligate midwifery as proposed by Trevathan, and with the underlying assumption that we still occupy Paleolithic bodies, then midwifery and other holistic models of care that focus on trust, building relationships, and reducing maternal stress hormones through intensive emotional and psychosocial support during labor partially explain the excellent outcomes associated with homebirth and other alternative models of care cited above. Current technocratic approaches vastly underestimate the evolved psychosocial and physiological needs of women in labor.

Low Intervention Birth – Long-term Breastfeeding – Co-sleeping Adaptive Complex

The intimacy and connectedness that facilitate human childbirth have also been extended and applied to early parenting behaviors and mother-baby coevolutionary patterns among primates. James McKenna (2003), an evolutionary biologist who focuses on early infant sleeping, breastfeeding and breathing patterns, has examined contemporary Western childrearing practices like solitary sleeping and scheduled nursing from the perspective of evolutionary medicine. His work challenges the basic assumption that solitary sleep should be considered “normal” for human babies, concluding instead that an understanding of evolutionary biology and cross-cultural and cross-species comparisons suggests that there are benefits to parent-infant co-sleeping and long-term, on-demand nursing (McKenna and McDade 2005; McKenna and Mosko 2001). These benefits include the promotion of early bonding, growth and neurological development in the newborn and, perhaps most importantly, the regulation of breathing patterns in altricial infants especially during stages of deeper sleep. Safe co-sleeping and nighttime breastfeeding may also be protective against Sudden Infant Death Syndrome (SIDS) in some contexts. McKenna argues that long-term breastfeeding and parent-infant co-sleeping are part of an adaptive complex for primates that evolved to allow for intensive parental investment, social learning and rapid postnatal brain growth in altricial infants (McKenna, Mosko and Richard 1999).

A growing number of birth and early parenting activists around the world are beginning to question the decline in continuous contact in childrearing that characterized parenting practices until four decades ago, when “plastic babysitter” technologies like monitors, swings, cribs and car seats began to replace continuous physical contact (DeLoache and Gottlieb 200; Hrdy 1999; Small 1999, 2001). Midwives and holistic pediatricians who value the external gestation period described by McKenna (2003) and others (Montague 1971; Trevathan and McKenna 2003) argue that more high-touch, alternative parenting practices often produce babies that are healthier (emotionally and physically) than bottle-fed, solitary-crib-sleeping and stroller-carried infants that are the norm under the technocratic paradigm.

Because we see birthing behaviors as inextricably linked to mother-baby co-evolution and early parenting adaptations like exclusive, on-demand breastfeeding and sensory proximity of mother and baby during sleep, we propose an extension of McKenna’s (2003) breastfeeding-co-sleeping adaptive complex to include low-intervention, physiologic birth as an approach that helps to decrease the discordance between human biology

and our technocractic culture. The alertness of unmedicated infants, combined with the evolutionary and premodern cultural norm of keeping the mother-baby-unit intact in the hours immediately following birth, facilitates the cascade of hormonally regulated mother-baby bonding that promotes exclusive and long-term breastfeeding (Ludington-Hoe, Hadeed, and Anderson et al. 1991a, 1991b; McKenna 2003; Odent 2007; Trevathan and McKenna 2003).

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We have reviewed what we see as remarkable similarities in human birth mechanisms and cultural practices over time and argued that, pre-Industrial Revolution, these similarities were an outgrowth of our common evolutionary heritage as bipedal primates. With industrialization, there emerged a fear-based need to control nature that, along with the hegemony of biomedicine, again produced relatively uniform cross-cultural birthing practices, though the later differ significantly from premodern norms. While we acknowledge the multiple culturally-mediated differences in the ritual treatment of birth, we are also struck by the remarkable similarities in premodern birthing practices in hunting-gathering, horticultural, agricultural, and pastoral societies. These births were characterized by freedom of movement, upright positions, midwives (or female relatives) in attendance, and breastfeeding and co-sleeping during the external gestation period. Our common evolutionary heritage as bipedal primates and the normal, instinctive physiology of birth were relatively honored in premodern societies.

In striking contrast, birth in the industrial and technocratic eras, while very similar cross-culturally, looks very different from what our the first four little pig mothers would have experienced — women flat on their backs, hooked up to intravenous lines and monitors and cared for by “intimate strangers”. This transformation away from what evolutionary biology might predict increases the discordance between the evolved physiology of human childbirth and contemporary cultural interventions. Using the lens of Evolutionary Medicine, we have identified several areas where premodern birthing and childrearing patterns can provide a corrective to current technocratic approaches that, we argue, do little to honor the Upper Paleolithic bodies we occupy. These areas include:

- structural-and institution-level changes needed to facilitate unrestricted movement in labor
- upright physiologic positions for pushing
- continuous labor support
- increased provider-mother connection through continuity of care
- removal of cultural and protocol constraints that inhibit the honoring of human external gestations through exclusive, long-term, on-demand nursing and technologies like co-sleepers and slings that increases vital, tactile stimulation of our infants.

Evolutionary approaches, while certainly not without limitations in that they carry their own set of contestable presuppositions, are valuable in as far as they provide yet another way of critically examining birth in cultures that supervalue science. We encourage biomedical researchers and clinical practitioners to consider not only the proximate or immediate contexts of an individual woman’s pregnancy, but also the larger, evolutionary history of our species that has shaped our biology and, to some extent, our culture and behaviors. In addition, we advocate a deeper and more explicit acknowledgment of the fact that recent human evolution has not unfolded within a power vacuum. Rather, the influences of industrialism, technocracy, and gendered power inequities have generated a biomedical hegemony that has been perpetrated around the world through both colonialism and the maladaptive imitation of what appears to be “best” because it is modern. Adjusting our critical lens to see birth within the larger and more holistic contexts of cross-cultural and evolutionary perspectives, we can combine the best of what technological innovations have to offer, while also embracing the wild beauty and instinctive power of the big bad wolf in the birthplace (Figure 6).

<<put figure 6 here>>

Figure 6. An untamed, physiologic, midwife-attended birth in Porto Alegre, Brazil, 2007 (Photograph by Ricardo Jones, MD).

Robbie Davis-Floyd

Melissa Cheyney

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[i] The story of the Three Little Pigs, for those who don’t know it, goes something like this: There were 3 little pig brothers and they all set out to make their way in the world. The first built a house of straw, the second a house of sticks, and the third a house of bricks. Eventually the big bad wolf came around. He saw the first house and said, “I’ll huff and I’ll puff and I’ll blow your house down.” He was able to blow down the houses of the first two pigs. But the third, stronger house withstood the wolf’s huffing and puffing, and the third pig was able to trap the wolf and kill him. The moral, probably, was that those who plan ahead and act upon those plans will prosper.

[ii] Davis-Floyd has proposed in many of her public presentations that the original story of the three little pigs, which is very ancient, was created by agriculturalists as a way of expressing their belief in the value of their subsistence strategy and their sense of superiority over all things “savage” and untamed by “civilization”.

[iii] See Davis-Floyd 1994, 1996, 2001a, 2001b, and Davis-Floyd and St. John 1998.

[iv] Genetic changes since the agricultural revolution include the malaria/sickle cell anemia balanced polymorphism, lactase persistence and vitamin D synthesis in Europeans (Allison 1954; Beall and Steegmann 2000; Durham 1991; Katz 1987).

[v] The Kalahari Ju/’hoansi, for example, value unassisted birth, though there is some disagreement about how many women actually achieve this cultural ideal. Some sources argue that mothers more commonly give birth surrounded by female relatives and friends (Konner and Shostack 1987; Shostack 1981), while Biesele (1997) has reported that solitary birth occurs not infrequently and that it is an important goal of Ju/’hoansi women as a means of “proving oneself,” as it also is for the women of Misima Island, Papua New Guinea (Byford 1999). Regardless, as Rosenberg and Trevathan (2001) assert, it is probably safe to generalize that the majority of cultures make some provision for assistance at birth.

[vi] Human babies are referred to as secondarily altricial. This means that although most mammals are precocial, meaning infants are born in a state that is relatively mature compared to the adult condition (think, for example, of the giraffe that gets up and walks around only minutes after birth), human babies have reverted back to the more primitive condition of being relatively altricial or helpless and immature relative to the adult condition at birth (Hrdy 1999). This pattern is viewed as a necessary compromise to allow relatively large brained infants to be born through a birth canal adapted for upright walking. As a result, human babies undergo a kind of extra-uterine gestational development where rapid brain growth continues for 12 months after birth. In precocial mammals and in nonhuman primates brain growth proceeds rapidly until birth and then slows dramatically after delivery. The

extension of human brain growth postnatally effectively gives humans a 21-month gestation (9 months *in utero,* 12 extra-uterine) (Lewin and Foley 2004).

[vii] Pitocin is the artificial version of oxytocin — the hormone that stimulates labor contractions. Pitocin is used to induce and augment labor artificially in 47% of births in the U.S (Declercq et al. 2006) and is increasingly commonly used even in the remote rural clinics of the developing world.

[viii] New Zealand, the Netherlands and the Scandinavian countries are all exceptions. These nations have rejected many of the routine technological interventions in childbirth advocated for in the United States and, instead, have embraced more holistic and midwifery model approaches. They also enjoy significantly improved maternal-child health outcomes relative to the U.S. with fewer dollars spent per capita (DeVries 2004; DeVries et al. 2001; Wagner 2006).

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BIRTH AND THE BIG BAD WOLF: AN EVOLUTIONARY PERSPECTIVE**[i]**

Robbie Davis-Floyd and Melissa Cheyney

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Once upon a time, there were six little pigs who set out to seek their fortunes in the world (okay, we know that in the original story there were only three, but just bear with us here!). Far away from home they journeyed, until the first little pig spied a peaceful meadow with a stream running through it; there he stopped his hot and weary journey. In two hours he had built himself a house of straw, then he spent another hour building animal traps, after which he set about to laugh and dance and play all day. It was like that every day — he would spend three to five hours hunting wild game, after which he could do as he pleased. The female pigs gathered wild grains, tubers and fruits so that food was available even when the hunt failed. Although the first little pig didn’t always like to admit it, the female pigs brought in 70%-80% of the diet from foraging, and often helped with the hunting and trapping as well. He was feeling very content, for he had wished to find an environment that could sustain him and his small band of kin pigs, and he had. Sure, he and his like-minded friends experienced high infant mortality rates and a resulting life expectancy of around 35 years, as well as high death rates from endemic disease and accidental death. However, as they discussed frequently in their abundant leisure time (in between the long stories they loved to tell), these problems were offset by their varied and nutritious diets and high mobility, which made sanitation and infectious disease transmission non-issues. Life was good and gender relationships egalitarian for the most part

The first little pig and his kith and kin were so successful at their hunting and gathering that after a couple hundred thousand years, they had overpopulated the most fertile areas of the world. Under pressure to feed so many mouths, necessity (the mother of all invention) was combined with the knowledge of plant life cycles

developed during the days of gathering to create a new subsistence strategy–horticulture. The second little pig and his matriline began to fell trees and to plant gardens, and for the first time in human history, planted foods to supplement those that were foraged. The work was harder and longer — it took five to six hours a day — but still they had plenty of leisure time for singing, dancing, and storytelling. The females did most of the work anyway, planting, cultivating, harvesting and processing the food they grew, and chopping wood and carrying water, while the males spent their time hunting and performing the rituals that assured them that all was, and would remain, as it should be. They built their houses of sticks because they were still semi-nomadic, moving their villages every five years as garden soil and large game populations were exhausted. This kept life interesting. The diet was highly varied and population densities low enough to keep infectious disease in check, and while the seeds of gender inequality were sown along with the first domesticated plants, for the most part, life was good for the horticultural pigs.

The third little pig was horrified at his brothers' lack of industriousness. He knew the danger they were in from the big bad wolf, and that silly little houses of straw and sticks stood no chance should the wolf try to huff and puff and blow them down. So he went much farther down the road and through the millennia, away from the wolf's territory, until he found a nice flat field good for planting, near a large river from which he could divert water for irrigation. He set to work building himself a sturdy house of wood and stone that the wolf could not blow down. It took him weeks of hard labor, working eight to ten hours a day to build the house, and then more weeks to dig the irrigation canals and plant his large field. He knew that his lazy hunter-gatherer and horticulturalist brothers would soon be coming to him for shelter and food, and he, the industrious agriculturalist, planned to be prepared.

*The third little pig and his friends enjoyed increased population densities as more of them settled down and committed to growing their food. Yes, there was less variability in what they had to eat, and food production was extraordinarily labor intensive, but with the availability of safe weaning foods, female pigs could nurse for shorter periods of time allowing for a return to fertility and shorter interbirth intervals so more little pigs could be born to work the fields and build the communities. Standing water from irrigation ended up being a pesky vector for mosquito-borne diseases like malaria, and sanitation and acute crowd infections became an issue, but agriculturalist pigs could also acquire possessions, own land and rise to the tops of social hierarchies, especially where female pig production and reproduction could be exploited. He was sure that he was much safer from the big bad wolf than his brother pigs who were still living in the forests, the jungles, and the wild fields where danger roamed.**[ii]** Life was good, although without much leisure, the third little pig didn't have as much time to enjoy it.*

The fourth little pig watched with resentment as intensive agriculture took over the most fertile land, and foraging and small-scale horticulture became marginalized. His desire to roam and explore new lands was the hunting-gathering legacy of wanderlust, and he had no desire to settle down. He gathered up his goat hair tent and began herding animals through agricultural territory, exploiting high hills, low valleys, the wild Northern steppes and the plains of Africa, developing humankind's fourth subsistence strategy — pastoralism — and enjoying his freedom. Because male pigs tended to own, care for and manage the herds, and because they often had to fight for rights of passage through agricultural lands, pastoral warrior cultures developed that functioned to enhance male pig power. Their domination of herding tended to be reflected in other aspects of social organization – including the near universality of patrilineal decent, patrilocal residence patterns and segregation of the sexes. Life was good for the male chauvinist pigs, but symbolic and social stratification by gender spelled trouble for females, especially where strict honor codes and the exchange of women as chattel challenged girl-pig autonomy.

The fifth little pig, watching the dependence of his brothers and sisters on nature and knowing its dangers, was sure he could improve on matters. Farming could be industrialized, and by moving into cities and building large tenements made of bricks that could sustain huge populations densities, a work force would be available to modify the fruits of agricultural labor into value-added products for sale under a capitalistic economic system. Yes, some exploitation of pig children and recent pig immigrants would be necessary and infectious disease rates would rise, especially where sanitation and food quality was poor, but the fifth little pig could also amass huge stores of material wealth because he owned the means of production. With eventual improvements in sanitation, basic public health interventions and an intentional decrease in family size as children became more expensive to raise, life expectancy would rise, providing a long lifetime over which to feel the intense need to buy the products produced in factories with innovative technologies and machinery. The fear of the big bad wolf would become a distant memory thanks to habitat destruction and the increasing distance of settlements from unmodified

landscapes. Life was good for the fifth little pig and his industrializing friends, especially when they could exploit natural resources and a cheap labor force in the other pigs' homelands.

*The sixth little pig was so far removed from nature that he lost all sense of its value and devoted himself to inventing complex technologies, building gleaming cities of glass and concrete, paving over all things green and putting as many products as possible into elaborate plastic wrappers with widely identifiable logos and branding. He developed a technocratic society**[iii]** organized around an ideology of progress through the development of high technology and the global flow of information. Beginning just a few decades ago, the forces of globalization, consumerism and neocolonialism transformed even the most remote agriculturalists into dependents in an exploitative, global economy that produces vast inequities between high and low-income nations. The sixth little pig and a few of his elite investor friends benefited, while many others struggled to access even the most basic of resources. Soon environmentalist pigs began to notice that the nature that they had worked so hard to tame through technology was turning on them as industrialization heated the planet, melted the glaciers, and polluted the atmosphere. The sixth little pig started to wonder whether he and his industrialist brother had gone too far.*

And sure enough, as we all know, the big bad wolf (who escaped from a zoo rehabilitation program) did in fact show up, and he huffed, and he puffed, and he blew down the houses of the little pigs, who all came racing over to the house of their technocratic brother, who let them in and slammed the door just in time! In the end, they were safe in the sixth little pig's McMansion where the big bad wolf could not harm them. But the first five little pigs were unhappy with the eighty-hour work week, lack of medical insurance and rampant consumerism, perceived needs and massive debt that the technocracy had to offer. They were frustrated by the lower status that was culturally assigned to them because of their "uncivilized" pasts. They felt uncomfortable in the air-conditioned home with the zero lot line, and missed the sounds of the wind in the trees. The first five little pigs became medical anthropologists and began to reflect on what had been lost when modernization became the primary goal during the Industrial Era. They realized with regret that the big bad wolf was nothing more than a metaphor for the wild, uncontrollable and chaotic natural world that pigs had been attempting to tame through culture. They didn't want to give up their cars, computers, and cell phones, but they did wonder…perhaps there was a lesson to be learned from the story of the big bad wolf?

Folktales often condense millennia of historical events into one short story, and this one is no exception. From the time of our emergence as *Homo sapiens,* perhaps as long as 195,000 years ago (McDougall, Brown and Fleagle 2005, White et al. 2003), we have lived as hunter-gatherers, picking fruit from trees, foraging wild grains, digging for vegetables, and hunting animals both large and small. The power of our own experiences, "living in the now", and the effects of socialization that make "normal" simply what we are used to, can obscure the fact that the technocratic society we know and reproduce in today accounts for less than 1% of human history (Table 1). Only 1-2% of our biological make-up has evolved since the ape-human split between five and seven million years ago, meaning that the vast majority of our genes are ancient in origin (Trevathan, Smith and McKenna 2008). There have been a few simple genetic changes since the third little pig and his wife invented agriculture around 10-12,000 years ago,[iv] but the pace of cultural evolution is generally much faster than biological evolution. As a result, humans today occupy 35,000-year-old model bodies that are not particularly well adapted to the technocratic and industrializing cultures many of us live in (Armelagos, Brown, and Turner 2005; Eaton, Eaton III, and Cordain 2002).

Subsistence Strategy	**Emergence (years before present)**
Hunting/Gathering	**>100,000**
(99% of human history)	
Horticulture	**12,000**
Agriculture	**10,000**
Pastoralism	**8,000**
Industrialism	**250**

Table 1. Human Subsistence Pattern Timeline.

One of the primary contributions of evolutionary approaches in anthropology has been to remind us that *Homo sapiens* today still live in Paleolithic bodies adapted for the stressors faced by the first little pig. Current diet, lifestyle and reproductive patterns are drastically different from those that produced the selective pressure under which humans and human childbirth evolved. This mismatch in genes and culture promotes, accelerates and fosters certain diseases, especially those associated with changes in diet, reduced exercise levels and excessively interventive and mechanistic approaches to childbirth (Cheyney 2003, 2005; Trevathan, Smith, McKenna 1999, 2008). The notion that discontinuities between the conditions under which humans evolved and the conditions we live in today produce dis-ease is called the "discordance hypothesis", and it forms the foundation for a relatively new subfield of Medical Anthropology called Evolutionary or Darwinian Medicine. This approach examines health conditions generated by the discordance between evolved biology and current culture and attempts to propose evolutionarily sound solutions or treatments (Stearns, Nesse and Haig 2008; Trevathan, Smith and McKenna 1999, 2008; Williams and Nesse 1991).

In this chapter, we discuss not the diversity in the ways childbirth is treated or culturally elaborated around the world as highlighted in the rest of this volume, but instead, we focus our attentions on the biocultural features that unite *Homo sapiens* as a species. We review what we see as remarkable similarities in human birth mechanisms and cultural practices over time and argue that, pre-Industrial Revolution, these similarities were an outgrowth of our common evolutionary heritage as bipedal primates. With industrialization, there emerged a fear-based need to control nature that, along with the hegemony of biomedicine, again produced relatively uniform cross-cultural birthing practices, though the latter differ significantly from premodern norms. We examine this shift in the cultural elaboration of birth at the onset of the Industrial Era and discuss three areas where current obstetric approaches can benefit from holistic, cross-cultural and evolutionary perspectives. Our approach is co-evolutionary, meaning that we focus on dual-inheritance, or the identification of relationships between evolutionary biology and culture (Hewlett, De Silvestri, and Guglielmino 2002). We use "biocultural" and "co-evolutionary" throughout to emphasize the interactions between genes, culture, behavior and unequal relationships of power (Goodman and Leatherman 1998) that combine to produce the cross-cultural birthing patterns we see today.

THE BIOCULTURAL EVOLUTION OF MODERN HUMAN CHILDBIRTH

The unique anatomical characteristics of the human pelvis and the complex delivery mechanisms they necessitate have occupied the research agendas of numerous evolutionary biologists (Lovejoy 1988; Rosenberg 1992; Rosenberg and Trevathan 1996; Trevathan 1987, 1988, 1997, 1999; Trevathan and Rosenberg 2000; Washburn 1960) since anthropologist Wilton Krogman (1951) first referred to childbirth as a "scar of human evolution". The difficulty of human childbirth relative to other primates (Stoller 1995) is thought to stem primarily from the so-called "obstetrical dilemma" or the conflicting evolutionary pressures on human pelvic shape that necessitate a relatively wide yet flattened pelvis to optimize energetically efficient muscular attachments required for bipedalism (Lovejoy 1988) on the one hand, and an open, rounded and spacious passageway for the birth of relatively large-brained infants on the other. These competing selective pressures have resulted in an obstetrical compromise that requires the passage of a fetal head that is nearly the same size or larger than the maternal pelvis. As a consequence, human babies, unlike their primate relatives, must maneuver through a series of complex orientations, called the cardinal movements or mechanisms of labor, as they travel through the changing diameters of the birth canal during delivery (Trevathan 1987, 1988, 1997, 1999; Trevathan and Rosenberg 2000) (Figure 1). As a result, researchers, with few exceptions (Walrath 2003, 2006), have tended to see human birth as more painful and of longer duration relative to other mammals and to non-human primates, though for healthy mothers and babies, not necessarily more dangerous.

<<put figure 1 here>>

Figure 1. Mechanisms or cardinal movements of human delivery in occiput anterior presentations (from Trevathan, Smith and Mckenna 1999: 196). PERMISSION requested from Oxford University Press

The comparatively difficult nature of parturition in our species has led researchers (Rosenberg 1992, 2003; Trevathan 1999) to hypothesize about the effects of our uniquely human obstetrical adaptations on changes in birthing behaviors and cultural norms over time. While non-human primates usually choose to give birth alone and under the cover of night, human mothers almost always seek out assistance from female relatives, friends and/or experienced birth attendants. Biological anthropologist Wenda Trevathan (1997, 1999) reasons that at some point in human history, the benefits of assisted birth would have outweighed the safety of solitary delivery. She finds support for this argument in the cross-cultural observation that very few societies idealize unassisted birth, and in those that do, solitary birth may only be expected of women who have already had one or more babies and/or in mothers with uncomplicated deliveries.[v]

This condition of "obligate midwifery", or the uniquely human need for an attendant, Trevathan (1997) argues, evolved in response to three important differences between the mechanisms of birth in humans relative to other primates. First, because human babies almost always emerge facing away from the mother (a position called occiput anterior), it is difficult for the mother to reach down, as non-human primates do, to catch the baby and to clear an airway or remove the umbilical cord from around the infant's neck (Figure 2). Secondly, modern humans give birth to secondarily altricial[vi] infants who require extensive care from the time of delivery. The relative helplessness of the human infant may be an additional reason why extra hands at a birth contribute to improved reproductive success, especially where mothers are exhausted by particularly long and difficult labors. Thirdly, Trevathan (1997) notes that powerful maternal emotions around labor and birth, including excitement, anxiety, fear, tension, joy and uncertainty, may have provided the evolutionary impetus for women to seek out support. The emotions of childbirth that encourage us to pursue assistance and companionship may be seen as biocultural adaptations to the physiological complications that result from bipedalism. Taken together, these three components of human birth may have contributed to the transformation of the process from a solitary to a highly social enterprise, setting humans on a trajectory toward social and cultural interventions in birth (Trevathan 1997).

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Figure 2. Solitary, occiput posterior delivery in nonhuman primates (from Trevathan 1987: 91, Drawings by Bryan McCuller). Permission requested from Aldine de Gruyter.

THE CULTURAL ELABORATION OF CHILDBIRTH: BIOMEDICAL HEGEMONY AND THE TECHNOCRATIC MODEL

Enter culture… At some point in human history, perhaps around a million years ago with the appearance of large-brained *Homo erectus*, as Karen Rosenberg (1992, 2003) has proposed, human ancestors began to seek assistance, and in so doing, initiated the transformation of birth from a solitary, biological process to a biocultural and social one. As the chapters in this volume demonstrate, the nuances of each culturally constructed birthing system — the dietary taboos, the ideal direction to face during delivery, the rituals considered necessary for a successful birth, the first words whispered into the ears of newborn babes — are limitless in their variety. However, a broad, historical view makes far more visible what the birthing systems of hunter-gatherers, horticulturalists, pastoralists, and agriculturalists have in common. Up until the Industrial Age just 250 years ago, the essential cultural practices associated with childbirth were relatively uniform. Women all around the world moved freely during labor, changing positions frequently as a method for managing the pain associated with labor contractions and cervical dilation. They ate and drank as they pleased within the cultural confines of what was considered acceptable, nourishing and safe for the mother and baby. They were attended by other women whom they knew well, in a place that was familiar to them — usually in their home or in the home of a female relative. They labored and birthed in upright positions using instinctive knowledge to expand the size of the pelvis, capitalize on gravity, and to maximize the efficiency of the abdominal muscles needed for pushing (Figure 3). They developed artifacts like birthing stools and chairs, threw ropes over beams to pull against, birthed in flexible hammocks, and used poles for support in order to facilitate upright birth. Midwives knelt down in front of the upright mothers to receive their babies. Newborns were kept with their mothers for warmth, and long-term exclusive breastfeeding, co-sleeping, slings and other technologies kept baby and mother close during a year or more of external gestation (McKenna 2003; Montague 1971; Trevathan and McKenna 2003).

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Figure 3. Childbirth woodcut showing an upright birthing position in Europe during the Middle Ages (From When Midwifery Became the Male Physician's Province: The Sixteenth Century Handbook: The Rose Garden for Pregnant Women and Midwives by Eucharius Rosslin, 1513 (Rosslin and Arons 1994: 31). Book is out of print.

These basic cultural adaptations were normative until the huge social changes associated with industrialization moved birth from home to hospital and fundamentally changed the cultural face of birth, while doing little to reduce mortality and morbidity (Cassidy 2006; Wertz and Wertz [1977] 1989; Wilson 1996). In fact, it was the industrialization of birth, not birth itself, that gave women the fear of birth they have today (Cassidy 2006; Ulrich 1990; Wertz and Wertz 1989; Wilson 1995). Before the widespread acceptance of germ theory, the large, unsanitary lying-in hospitals of industrialized nations produced massive epidemics of puerperal or childbirth fever in the 18th, 19th and early 20th centuries (Crawford 1990; Leavitt 1986; Pollock 1990, 1997). Women died by the thousands in the lying-in hospitals of Europe and the United States until the germ theory of disease became accepted in the late 19th and early 20th centuries. As a result, massive precautions were taken in hospitals to prevent or decrease puerperal fever and other infections with a primary focus on attempts at sterilizing, standardizing and managing the birth process. Birthing mothers were painted from breasts to knees with orange iodine, forbidden to touch their own infants, and separated from them after birth, sometimes for days, even though more infections started (and still start) in nurseries than in babies kept with their mothers (Bertini et al. 2006; James et al. 2008; McDonald et al. 2007; Nguyen et al. 2007). Ritualized procedures like enemas and pubic shaving were instituted under the premise that they would prevent infections. It has taken decades of research to show definitively that such practices do not in fact decrease rates of infection; they were implemented because of cultural categories and unfounded beliefs and are still common in developing countries (Cuervo, Rodriguez, and Delgado 2000; Baservi and Lavender 2001; Reveiz, Gaitan, and Cuervo 2007).

Over the last 40 years, the interventions that were introduced into the birthplace during industrialization have multiplied as societies like the United States have embraced high-tech, invasive solutions. As a result, much of our knowledge of unmedicated birth has been lost (Davis-Floyd 2001b). Physicians have been de-skilled and often no longer know how to attend normal deliveries patiently. After all, why learn how to attend a vaginal breech birth when a cesarean is so much easier (for the physician), and often more lucrative, to perform? As birth became more medicalized around the world, in most places, midwives lost their prestige as the guardians and guides at normal deliveries, becoming subordinated to physicians and trained out of traditional practices toward more industrial and technocratic approaches to birth.

Yet a midwifery revival is taking place — as more and more midwives realize what is being lost, they are working to regain their positions as the keepers and researchers of knowledge about physiologic birth, speaking and practicing outside the dominant paradigm, holding open a conceptual space where technocratic birth may be challenged (Cheyney 2008; Davis-Floyd 1992, 1997, 2001a, 2003, 2004; Davis-Floyd and Johnson 2006; Downe 2004). Biomedical hegemony, or the power-laden rule by cultural consent that constructs some models as authoritative (Jordan 1997) and others (like the midwifery models of care) as fringe, retrogressive and uncivilized, means that today, birth looks quite similar all over the world, yet quite different from the kind of births the wives of the first four little pigs would have experienced.

Today, as a result of the transformation of birth during the industrial and technocratic eras, women are not allowed to eat, drink, or walk around during labor. Dressed in hospital gowns and hooked up to intravenous lines that often carry pitocin[vii], prophylactic antibiotics and narcotics for pain, they give birth flat on their backs or in semi-sitting positions. The most notable differences in the contemporary medical treatment of birth have little to do with the specific customs of particular cultures, but instead, are more closely tied to the vast disparities between resource-rich and resource-poor countries. In most high-income nations, women receive significantly more interventions with pharmaceuticals and technologies applied at a higher rate, in more attractive and humane hospital settings. In most low-income nations, women receive less expensive and often outdated interventions like shaving, enemas, and episiotomies without the benefits of expensive interior decorating. In both rich and poor countries, cesarean rates are rising exponentially without a concomitant improvement in maternal

and fetal health outcomes (Althabe et al. 2006; Wagner 2006). Cultural differences and traditions have been largely obscured by the highly influential and heavily standardized biomedical hospital procedures now common in almost all industrialized and industrializing nations.[viii] Technology has tamed the big bad wolf, damming, controlling and homogenizing the raw, elemental power of birth. However, the rapidly rising rates of iatrogenic morbidity, and in some places, the rising rates of perinatal and maternal mortality due to excessive obstetrical intervention (Betran et al. 2007, Liu et al. 2007, Villar et al. 2006, 2007) suggest that perhaps we have lost something in the process. What does the big bad wolf still have to teach us?

preModern Birthing Patterns and Why they Matter

Returning to the discordance hypothesis as applied to childbirth and the lens of Evolutionary Medicine, we have identified several areas where the conditions under which human childbirth evolved differ so substantially from the cultural norms enforced under technocratic models of birth that they require closer examination. Cross-cultural midwifery approaches, with their often-explicit rejection of the key components of the technocratic model, combined with their subversive application of time-honored behaviors and premodern traditions, provide an important point of comparison for critically examining contemporary, technocratic practices. The cross-cultural midwifery norms, for example, of encouraging movement in labor, upright pushing positions, the provision of intensive emotional support during labor, along with active encouragement of long-term breastfeeding and co-sleeping adaptive complexes are associated with significantly improved psychosocial and clinical outcomes for both mother and baby (McKenna, Mosko and Richard 1999; McKenna and McDade 2005).

We propose that midwifery and other low-tech, high-touch models of care that attempt to preserve “natural” (read those with a long history in human and non-human primates) birthing practices, produce the positive outcomes documented in so many studies, because they reduce the discordance between evolutionary biology and recent culture. The do this via a mechanism that promotes working with, rather than against, the evolved biological and psychosocial needs of human mothers (Anderson and Murphy 1995; Durand 1992; Fullerton, Navarro, and Young 2007; Janssen, Holt, and Myers 1994; Janssen et al. 2002; Johnson and Daviss 2005; Murphy and Fullerton 1998; Rooks 1997; Schlenzka 1999). A closer examination of the premodern, reclaimed midwifery practices listed above, through the lens of Evolutionary Medicine, provides a clear, evidence-based template for the reform of contemporary, technocratic models of birth.

Unrestrained Movement in Labor Followed by Upright, “Physiologic” Pushing

Freedom of movement in labor used to be a cross-cultural norm, as it is in our closest living primate relatives, and the notion that women should lie in bed with their ability to self-comfort hindered by tubes and devices for fetal monitoring or intravenous fluid delivery is relatively recent and one that makes little sense from an evolutionary perspective (Trevathan 1999). There is a large body of clinical research that documents the value of upright postures and mobility during the first stage of labor (the stage where the cervix dilates) for speeding and easing the complicated descent through the pelvis that is unique to humans (Bodner-Adler et al. 2003; Gupta and Hofmeyr 2004; Gupta and Nikodem 2000). Upright postures maximize the dimensions of the pelvis, while improving blood flow to the baby by preventing compression of the large vessels that run along the mother’s spine, supplying the uterus with oxygenated blood. Women who deliver outside the technocratic model with midwives or holistic physicians tend to labor and push in upright positions in accordance with the physiologic urges that come with an unmedicated second stage (the stage where the baby moves down through the birth canal and is born) (Cheyney 2005; Davis-Floyd et al. 2009). Epidural rates of close to 80% in U.S. hospitals (Declercq et al. 2006), however, prevent most women from utilizing the well-documented benefits of upright labor and pushing positions like squatting that optimize the curve of the human birth canal called the Curve of Carus (Figures 4 and 5).

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Figure 4. Changes in the Curve of Carus with Maternal Positioning (from Sutton and Scott 1996:55). This book is out of print.

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Figure 5. Homebirth mother reclaiming a premodern birthing position, assisted by midwives, assisted by the comforting effects of water made possible by the high-tech, hot tub (Photo by Peter Gonzalez).

Technocratic models of pushing rely instead on a technique called "laboring down," meaning that epidurally administered medications are stopped or slowed during pushing so that mothers can regain enough sensation to feel and follow the physiologic urge to push. However, because the numbing and temporarily paralyzing effects of spinal or epidural anesthesia take a variable time to recede, women often begin to feel the urge to push and yet cannot move freely to maximize their efforts. This means that most women who deliver under the technocratic model do so in a semi-sitting position with restricted movement. Many will, of course, still go on to birth vaginally. However, for those women with a tighter fit, the inability to move into more upright pushing positions, as well as the reduced ability to feel the urge to push, may mean the difference between a vaginal and a surgical delivery. Non-physiologic pushing, we argue, partially explains the high rates of cesarean delivery and associated maternal and neonatal morbidity that characterizes modern, technocratic obstetrics (Althabe et al. 2006). [Editor's note: See the chapter by Travis Harvey and Lila Buckley that suggests that fear of childbirth pain is the prime motivation for cesarean in Chinese women.]

Obligate Midwifery, Continuous Labor Support and the Avoidance of "Intimate Strangers"

The intimacy of time-intensive, continuous labor support provided by birth attendants who are a part of a woman's community or have come to know her well over the course of her pregnancy may play an additionally decisive role in how human birth unfolds. The calming presence of a familiar midwife or other companion may, for example, help to mitigate levels of stress hormones like cortisol and epinephrine that are known to inhibit the effects of oxytocin — the hormone that stimulates labor contractions (Jolly 1999). The complex evolutionary relationships between hormones produced during fear and/or pain responses and those that stimulate labor combine to produce what have been called the "white coat" and "weekend" effects in humans and in non-human primates, respectively. These effects are characterized by the lessening or complete cessation of labor contractions when women and other primates feel afraid or anxious in response to being observed by doctors ("white coats") and/or researchers. Where women experience a decrease in labor contractions in response to fear or uncertainty (compensated for in the hospital by the administration of pitocin), non-human primate mothers who live in captivity are often able to delay delivery until their attendants leave the holding facility (hence the "weekend" effect).

The release of adrenaline and cortisol in response to fear and stress, and the consequent slowing of labor, may have served an adaptive function in the past because such mechanisms prevent mammals — humans included — from delivering fragile infants under conditions of predatory danger. However, fears of pain, the hospital, specific procedures (like the placement of an IV catheter), or even just the feeling of self-consciousness that can come with laboring in front of "intimate strangers", and the contraction-dampening effects of stress hormones are less beneficial in a technocratic environment where delivery must occur according to a relatively rigid time schedule to be considered "normal". If human childbirth evolved under conditions of obligate midwifery as proposed by Trevathan, and with the underlying assumption that we still occupy Paleolithic bodies, then midwifery and other holistic models of care that focus on trust, building relationships, and reducing maternal stress hormones through intensive emotional and psychosocial support during labor partially explain the excellent outcomes associated with homebirth and other alternative models of care cited above. Current technocratic approaches vastly underestimate the evolved psychosocial and physiological needs of women in labor.

Low Intervention Birth – Long-term Breastfeeding – Co-sleeping Adaptive Complex

The intimacy and connectedness that facilitate human childbirth have also been extended and applied to early parenting behaviors and mother-baby coevolutionary patterns among primates. James McKenna (2003), an evolutionary biologist who focuses on early infant sleeping, breastfeeding and breathing patterns, has examined contemporary Western childrearing practices like solitary sleeping and scheduled nursing from the perspective of evolutionary medicine. His work challenges the basic assumption that solitary sleep should be considered "normal" for human babies, concluding instead that an understanding of evolutionary biology and cross-cultural and cross-species comparisons suggests that there are benefits to parent-infant co-sleeping and long-term, on-

demand nursing (McKenna and McDade 2005; McKenna and Mosko 2001). These benefits include the promotion of early bonding, growth and neurological development in the newborn and, perhaps most importantly, the regulation of breathing patterns in altricial infants especially during stages of deeper sleep. Safe co-sleeping and nighttime breastfeeding may also be protective against Sudden Infant Death Syndrome (SIDS) in some contexts. McKenna argues that long-term breastfeeding and parent-infant co-sleeping are part of an adaptive complex for primates that evolved to allow for intensive parental investment, social learning and rapid postnatal brain growth in altricial infants (McKenna, Mosko and Richard 1999).

A growing number of birth and early parenting activists around the world are beginning to question the decline in continuous contact in childrearing that characterized parenting practices until four decades ago, when "plastic babysitter" technologies like monitors, swings, cribs and car seats began to replace continuous physical contact (DeLoache and Gottlieb 200; Hrdy 1999; Small 1999, 2001). Midwives and holistic pediatricians who value the external gestation period described by McKenna (2003) and others (Montague 1971; Trevathan and McKenna 2003) argue that more high-touch, alternative parenting practices often produce babies that are healthier (emotionally and physically) than bottle-fed, solitary-crib-sleeping and stroller-carried infants that are the norm under the technocratic paradigm.

Because we see birthing behaviors as inextricably linked to mother-baby co-evolution and early parenting adaptations like exclusive, on-demand breastfeeding and sensory proximity of mother and baby during sleep, we propose an extension of McKenna's (2003) breastfeeding-co-sleeping adaptive complex to include low-intervention, physiologic birth as an approach that helps to decrease the discordance between human biology and our technocractic culture. The alertness of unmedicated infants, combined with the evolutionary and premodern cultural norm of keeping the mother-baby-unit intact in the hours immediately following birth, facilitates the cascade of hormonally regulated mother-baby bonding that promotes exclusive and long-term breastfeeding (Ludington-Hoe, Hadeed, and Anderson et al. 1991a, 1991b; McKenna 2003; Odent 2007; Trevathan and McKenna 2003).

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We have reviewed what we see as remarkable similarities in human birth mechanisms and cultural practices over time and argued that, pre-Industrial Revolution, these similarities were an outgrowth of our common evolutionary heritage as bipedal primates. With industrialization, there emerged a fear-based need to control nature that, along with the hegemony of biomedicine, again produced relatively uniform cross-cultural birthing practices, though the later differ significantly from premodern norms. While we acknowledge the multiple culturally-mediated differences in the ritual treatment of birth, we are also struck by the remarkable similarities in premodern birthing practices in hunting-gathering, horticultural, agricultural, and pastoral societies. These births were characterized by freedom of movement, upright positions, midwives (or female relatives) in attendance, and breastfeeding and co-sleeping during the external gestation period. Our common evolutionary heritage as bipedal primates and the normal, instinctive physiology of birth were relatively honored in premodern societies.

In striking contrast, birth in the industrial and technocratic eras, while very similar cross-culturally, looks very different from what our the first four little pig mothers would have experienced — women flat on their backs, hooked up to intravenous lines and monitors and cared for by "intimate strangers". This transformation away from what evolutionary biology might predict increases the discordance between the evolved physiology of human childbirth and contemporary cultural interventions. Using the lens of Evolutionary Medicine, we have identified several areas where premodern birthing and childrearing patterns can provide a corrective to current technocratic approaches that, we argue, do little to honor the Upper Paleolithic bodies we occupy. These areas include:

- structural-and institution-level changes needed to facilitate unrestricted movement in labor
- upright physiologic positions for pushing
- continuous labor support
- increased provider-mother connection through continuity of care

- removal of cultural and protocol constraints that inhibit the honoring of human external gestations through exclusive, long-term, on-demand nursing and technologies like co-sleepers and slings that increases vital, tactile stimulation of our infants.

Evolutionary approaches, while certainly not without limitations in that they carry their own set of contestable presuppositions, are valuable in as far as they provide yet another way of critically examining birth in cultures that supervalue science. We encourage biomedical researchers and clinical practitioners to consider not only the proximate or immediate contexts of an individual woman's pregnancy, but also the larger, evolutionary history of our species that has shaped our biology and, to some extent, our culture and behaviors. In addition, we advocate a deeper and more explicit acknowledgment of the fact that recent human evolution has not unfolded within a power vacuum. Rather, the influences of industrialism, technocracy, and gendered power inequities have generated a biomedical hegemony that has been perpetrated around the world through both colonialism and the maladaptive imitation of what appears to be "best" because it is modern. Adjusting our critical lens to see birth within the larger and more holistic contexts of cross-cultural and evolutionary perspectives, we can combine the best of what technological innovations have to offer, while also embracing the wild beauty and instinctive power of the big bad wolf in the birthplace (Figure 6).

<<put figure 6 here>>

Figure 6. An untamed, physiologic, midwife-attended birth in Porto Alegre, Brazil, 2007 (Photograph by Ricardo Jones, MD).

Robbie Davis-Floyd

Melissa Cheyney

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[i] The story of the Three Little Pigs, for those who don’t know it, goes something like this: There were 3 little pig brothers and they all set out to make their way in the world. The first built a house of straw, the second a house of sticks, and the third a house of bricks. Eventually the big bad wolf came around. He saw the first house and said, “I’ll huff and I’ll puff and I’ll blow your house down.” He was able to blow down the houses of the first two pigs. But the third, stronger house withstood the wolf’s huffing and puffing, and the third pig was able to trap the wolf and kill him. The moral, probably, was that those who plan ahead and act upon those plans will prosper.

[ii] Davis-Floyd has proposed in many of her public presentations that the original story of the three little pigs, which is very ancient, was created by agriculturalists as a way of expressing their belief in the value of their subsistence strategy and their sense of superiority over all things “savage” and untamed by “civilization”.

[iii] See Davis-Floyd 1994, 1996, 2001a, 2001b, and Davis-Floyd and St. John 1998.

[iv] Genetic changes since the agricultural revolution include the malaria/sickle cell anemia balanced polymorphism, lactase persistence and vitamin D synthesis in Europeans (Allison 1954; Beall and Steegmann 2000; Durham 1991; Katz 1987).

[v] The Kalahari Ju/'hoansi, for example, value unassisted birth, though there is some disagreement about how many women actually achieve this cultural ideal. Some sources argue that mothers more commonly give birth surrounded by female relatives and friends (Konner and Shostack 1987; Shostack 1981), while Biesele (1997) has reported that solitary birth occurs not infrequently and that it is an important goal of Ju/'hoansi women as a means of "proving oneself," as it also is for the women of Misima Island, Papua New Guinea (Byford 1999). Regardless, as Rosenberg and Trevathan (2001) assert, it is probably safe to generalize that the majority of cultures make some provision for assistance at birth.

[vi] Human babies are referred to as secondarily altricial. This means that although most mammals are precocial, meaning infants are born in a state that is relatively mature compared to the adult condition (think, for example, of the giraffe that gets up and walks around only minutes after birth), human babies have reverted back to the more primitive condition of being relatively altricial or helpless and immature relative to the adult condition at birth (Hrdy 1999). This pattern is viewed as a necessary compromise to allow relatively large brained infants to be born through a birth canal adapted for upright walking. As a result, human babies undergo a kind of extra-uterine gestational development where rapid brain growth continues for 12 months after birth. In precocial mammals and in nonhuman primates brain growth proceeds rapidly until birth and then slows dramatically after delivery. The extension of human brain growth postnatally effectively gives humans a 21-month gestation (9 months *in utero,* 12 extra-uterine) (Lewin and Foley 2004).
[vii] Pitocin is the artificial version of oxytocin — the hormone that stimulates labor contractions. Pitocin is used to induce and augment labor artificially in 47% of births in the U.S (Declercq et al. 2006) and is increasingly commonly used even in the remote rural clinics of the developing world.
[viii] New Zealand, the Netherlands and the Scandinavian countries are all exceptions. These nations have rejected many of the routine technological interventions in childbirth advocated for in the United States and, instead, have embraced more holistic and midwifery model approaches. They also enjoy significantly improved maternal-child health outcomes relative to the U.S. with fewer dollars spent per capita (DeVries 2004; DeVries et al. 2001; Wagner 2006).

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