

The Start of A New Human Life:
Maximizing Well-Being in the Trade-Off
Between Economic Wealth and Spiritual Richness

- or -

What Can South Teach North About Raising A Kid?



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DEDICATORIO

*A mis hijos, Daniel y Melanie,
y todos los niños del mundo,
para que no sean ni tan pobres ni tan ricos.*

EPIGRAPH

Your children are not your children.
They are the sons and daughters of Life's longing for itself.
They come through you but not from you,
And though they are with you, yet they belong not to you.
You may give them your love but not your thoughts.
For they have their own thoughts.
You may house their bodies but not their souls,
For their souls dwell in the house of tomorrow, which you cannot visit, not even in your dreams.
You may strive to be like them, but seek not to make them like you.
For life goes not backward nor tarries with yesterday.
You are the bows from which your children as living arrows are sent forth.
The archer sees the mark upon the path of the infinite, and He bends you with His might that His
arrows may go swift and far.
Let your bending in the archer's hand be for gladness;
For even as he loves the arrow that flies, so He loves also the bow that is stable.

-- *The Prophet*, Kahlil Gibran (1923), *On Children*

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ABSTRACT

The first half of this work forms a theoretical framework for analyzing how power is used in economic and ecological systems. The flow of the chapters builds a logical argument towards a mathematically-based framework for analyzing population data related to child-raising as it scales with the human individual's relation with the environment:

THE PROLOGUE: Establishes my perspective as a Southern migrant from Ecuador to the U.S. and the resultant ability to view both cultures through a distant and inquiring lens. I also lay on the table some important aspects of my own world view that have guided me throughout the Ph.D. program and my dissertation work.

CHAPTER ONE: This introductory chapter forms the basis for a unified approach to economic and ecological systems by establishing the relationship between energy, power, money and the contrast between physical and spiritual uses of power. This is done principally by analyzing why both economics and ecology, as disciplines, have rarely focused on the use of power in child-raising, despite the fact that this must be a key use—perhaps THE key use—of power in both disciplines. The significance of the use of power in starting a new human life is presented and leads to the question of what a sustainable use of power might mean.

CHAPTER TWO: This chapter builds on fundamental features of living systems—growth and self-regulation—to suggest that the language and concept of sustainability might be over-general and best avoided. By looking at cycles of growth, complexity, collapse and regeneration, I come to the conclusion that maximizing individual fulfillment—in both a physical/economic and spiritual sense, recognizing that these are often in conflict—might be the best way of understanding and striving for sustainability.

CHAPTER THREE: Here I present my view of how economic and ecological approaches to understanding human-environment interactions should be considered part and parcel of the same discipline. I build on the work of four authors—James Baldwin, Carl Sauer, Michael Pollan and Gerrat Vermeij—to elaborate “Seven Simple Truths” that encapsulate my understanding of how energy cycles through economic/ecological systems, and how physical and spiritual types of energy can be in competition. This chapter brings forth what I believe are the two intellectually original contributions—theoretically—that my dissertation will provide. The first is an attempt to de-mystify what “spiritual energy or power” might actually be or how it might be represented, which is the principal topic for Chapter Four. The second is a mathematical framework for analyzing scaling data from the perspective of maximizing fulfillment, which is the principal topic for Chapter Five.

CHAPTER FOUR: In this chapter, I build on the fundamental physical relationship between power, energy and time to establish a mathematical “power use” space. In this space, human metabolic power use is separated (on low-sloped lines) from human extra-metabolic power use (which is found on steeper-sloped lines). Spiritually oriented uses of power tend to be in the metabolic power use range, while more physically, and money-intensive, uses of power are on steeper extra-metabolic sloped lines. Given that a complex system, like a person or a city, can only be at one level of energy use at any given time, this power use space opens the question of how different aspects of child-raising scale with power use.

CHAPTER FIVE: This chapter serves as a critique of traditional measures of population performance, such as GDP. I review what other alternative measures are available and look at how these metrics relate to my own perception of sustainability developed in Chapter Two.

CHAPTER SIX: Building on the work of Vermeij (2004) and Moses and Brown (2003), I argue strongly for the primacy of scale in determining how power use can be maximized. I present Moses and Brown's analysis of how fertility rates among mammals, including humans, scales with power use. I then put forth the question of where maximal fulfillment might lie on a given scaling relationship, using Moses and Brown's example, as well as another example from food provisioning and diet. Finally, I return to Vermeij's five aspects of scaling that should be analyzed in understanding the performance, or power use

cycling, for living systems as a place to launch the next section of my dissertation, which will analyze populational and individual power use data related to child-raising.

The second half of the work presents my data on child-raising practice,s comparing experiences in Ibarra, Ecuador and Prescott, Arizona. Data come from the government-run pre-school centers in these cities and include anecdotal data obtained from interviews with families, along with quantitative, scalable data from the centers' standard intake and evaluation forms. The Ibarra and Prescott data are compared with the massive, comprehensive, longitudinal study of child-raising in England, the Millennium Cohort Study (see Appendix One for details on data sources). Where appropriate, I also compare my finding with world-level statistics from various organizations.

CHAPTERS 7-9: These chapters are each dedicated to presenting data results and analyses from a particular stage of child-raising (Chapter 7 is Pregnancy and Birth; Chapter 8 is Infancy and Toddlerhood; Chapter 9 is Early Childhood). My results show that parents, especially in Northern countries, believe they take rational decisions about child-raising practice from a full range of possibilities. However, in reality, their choices are constrained by the power-level, or income bracket within which they conduct their lives. Lower-income, lower-power-use families tend to adopt more direct-contact, metabolic-level, spiritual approaches to child-raising. These include non-intervention, vaginal births, long periods of breast-feeding, intensive family contact and involvement with children during their infancy, toddler and pre-school years, including mothers' presence at pre-school centers. Higher-income, higher-power-use families tend to adopt more economically-based, non-contact approaches to child-raising. These include high levels of medical intervention during pregnancy and childbirth, almost exclusive bottle-feeding of infants and low levels of parental and family involvement.

Among some high-power-use communities, an alternative lifestyle permits the reneging of dominant cultural approaches and the use of more direct-contact and spiritual approaches. However, these communities are a marginal part of U.S. mainstream and the vast majority of families are unable to escape from the constraints that their power-use or income level puts on the kinds of child-raising practices they adopt.

Future studies should move towards analyzing, when possible quantitatively, the effect of metabolic-level activities and spiritual approaches to child-raising so that a baseline of data can be accumulated showing the importance of these activities, especially relative to the abundance of standardized evaluative and testing data that are all biased by the cultural norms which enforce high-power-use approaches to child-raising.

KEY WORDS: Sustainability Education; Child-Raising; Power Use; North versus South; Growth; Collapse; Spiritual Energy Use; Economics; Ecology; Human Ecology; Metabolic Energy Use; Extra-Metabolic Energy Use; Pregnancy; Childbirth; Breast-Feeding; Infancy; Toddlers; Early Childhood; Education; Prescott, Arizona; Ibarra, Ecuador

PROLOGUE: The reverse transfer of technology and cultural values. South to North.

"La educación como un hecho social es un proceso de comunicación profunda entre el mundo interior y el exterior, que desarrolla las potencialidades del ser humano, quien en el trabajo transformará su mundo en busca de justicia social y dignidad, a fin de lograr la inter-independencia (independencia con mutua relación) real.

"Es comunicación profunda, no significa solamente conversar o intervenir para decir algo, significa, sobre todo, reconocerse como persona con identidad individual y social, con cultura y con capacidad de organización. Significa, también respetarse respetando a los demás, rescatar las posibilidades, habilidades, aptitudes, vivencias, experiencias, conocimientos, saberes; es decir, potencialidades para, a base de ellas, crecer, crear, imaginar y cambiar."

[Education as a social deed is a process of profound communication between interior and exterior worlds, which develops the potential of human beings, who through work will transform their world in search of social justice and dignity, with the goal of achieving real inter-independence (independence with mutual accord).

[It is profound communication, meaning not just conversing or intervening to say something, but, more than anything, knowing oneself as a person with individual and social identity, with culture and with the capacity for organization. It also means respecting oneself while respecting others, rescuing the possibilities, abilities, aptitudes, life experiences, understandings, knowledge; that is to say the potentialities that form the basis to grow, create, imagine and change]

--Juan E. Díaz Bordenave (1998)

A Story

In the mid-1990's, the *Gringos*, as Ecuadorians fondly refer to anyone of European or North American descent, came to Mariscal Sucre, the small town where I grew up, and where I still return every year. They purchased a large tract of forested land on the hills above town, what we call *monte* or "brush"—land that local people might have cleared for planting potatoes or turning to pasture. They called their land "Reserva Ecológica Guandera," the "Guandera Ecological Reserve" and promoted it as one of the last true high altitude inter-Andean cloud forests. The first *Gringo*, a scientist, who came and stayed for a few weeks, did a study on the distribution of frog populations. To this day, some people in town believe that the *Gringos* bought the land to raise frogs for import far away where people eat their legs. These town people believe this is the most rational explanation for what the *Gringos* are doing.

Based on their own conservation worldview, the *Gringos* came to help us save our forest. We are not a poor people, neither economically nor culturally, but we are humble and stoic, and it takes time and a soft approach to appreciate how we live our lives. The townspeople are dedicated to producing potatoes

and raising milk-cows and this is how they make their living. Most of the North Americans and Europeans who have come through the Foundation that bought the local land are smart, worldly people who bring friendship, and a genuine desire to help. They are also, at times, very unaware of their own limitations. For the townspeople some of what the *Gringos* do seems misguided and even bumbling. For instance, the *Gringos* spent thousands of dollars buying unproductive forest, and then implemented agricultural outreach programs in the town. The programs showed their ignorance about how to make our fertile land produce, and the forest that they were unwilling to cut only showed, from the townspeople point of view, how little they know about productive farming. The *Gringos* paid trucks, and then our local strong guys, to carry heavy Eucalyptus poles into the reserve to build their guesthouse, even though better and readily accessible trees surround the house. They are concerned about garbage on the streets, but they carry in great quantities of canned and packaged food into the ecological reserve, and the few visitors there produce more weekly garbage than the whole town.

At the time, as a university student in Natural Resource Engineering, I approached the Foundation that was running the reserve, and gained permission to do my research and thesis on the environmental impacts of eco-tourism in the reserve. I started to work for the Foundation and eventually became their coordinator for Environmental Education. This provided me with great insight into their worldview. While they sincerely believe that their mission is to save tropical forest, it is also a business and one that supports them well. On the other hand, my own townspeople can be very set in their ways and unwilling to accept, or even analyze, ideas that come from outside. I began to see my own role as one of empowering the community so that everyone could share ideas on an equal footing. However, as we began to take more and more local control of the reserve, some townspeople were overly aggressive, and the Foundation was not receptive. I became concerned that the situation could become violent, and as a pacifist, I decided to leave the Foundation and continue my education. To this day, these experiences are formative in my understanding of the vast gaps in understanding that can divide people with different worldviews.

An analysis

When I moved to the U.S. after completing my Master's Degree, I came to realize that the situation in Mariscal Sucre and Guandera are a microcosm of how rich and poor, industrialized and agricultural, developed and "under"-developed, South and North interact. Of course my experiences are simply one small part of a much larger historical context that has guided and determined perceptions, and the reality, of world geography today.

I have, by necessity, become a fascinated observer of cultural constraints, of the way in which people's societal and formative values keep them from using the resources that they have available in a beneficial, or at least benevolent, way. In fact, despite the tremendous economic and intellectual wealth available at our fingertips in the North, ingrained cultural values lead to behaviors that decrease individual and social welfare while increasing suffering. I'm not talking here about suffering among the economically poor in the South; I mean suffering, based on increased economic resources, among the same money-wealthy North. The prime source of Northern Power in today's world is access to information. However, increases in the amount of knowledge cannot come without concomitant losses (Daly and Farley, 2004), and the losses are not only informational, but also spiritual. As knowledge and physical resource bases grow, the survival and communication skills which bring plenitude and fulfillment are frequently lost; and they are replaced by angst, anguish, and psychological imbalance that lead to decreased welfare, increased suffering, and in extreme cases, the waging of horrible violence and war.

My lifeworld, then, as a mindful observer and researcher (Bentz and Shapiro, 1998), has been increasingly shaped by these cross-cultural encounters. Recognizing that I carry a privileged view from continents on both sides of the economic development divide, I've tried to harness the power of this perspective in formulating a notion of what sustainability is, how it might improve human welfare and well-being, and how the Southern worldview might help achieve this. The premise for the work that follows, then, is the balance between physical wealth and spiritual richness in *The Start of A New Human Life*, from conception through child-hood. Or...*What Can South Teach North about raising a kid?*

North and South—What do they mean?

As an addendum to these experiences with the cultural divide, I might add that we can no longer look at the North-South divide as strictly geographic. The notion of an isolated “3rd World” made up of entire countries and regions that are impoverished has long been false as globalization and urbanization bring pockets of high economic wealth to “under-developed” countries (Gilbert, 1993; Varela, 1998); while at the same time, many traditionally “1st World” countries have seen their most economically impoverished populations overlap with 3rd world levels of economic poverty (Ariza, 2003; Kneebone and Garr, 2010; Rosling, 2009). However, during the course of writing this thesis, I’ve also come to realize that North and South worldviews are also overlapping geographically and culturally (Sarmiento, 2003), principally through economic migration that brings South views into the U.S., especially from Latin America, and the exportation of cultural works (especially TV and cinema) and propaganda that create a North mind-set among wealthy Southern urban-dwellers (Gordon et al, 2010). Throughout this work, I’ll use the terms North and South to refer to a mind-set and lifestyle, but always recognizing that even the mind-set is no longer geographically isolated.

As Lewis and Wigen (1997) have so elegantly pointed out, even the way we divide our planet into continents, although presented as a physical reality, is in fact a cultural construct. They bring a profound historical view to how notions of East, West, North and South have developed, finally arguing for re-conceptualizing Europe as Western Eurasia, and the Americas as a continent that is culturally and physically divided into North America, Ibero-America and African-America. In many respects, my conceptualization of “South” is in large part what they would consider Ibero-America, although culturally many, especially wealthy, Ibero-Americans and many who live in the geographically northern U.S. and Canada, might now be considered part of North America. At the same time, some populations in the southerly geographic Ibero-America, again especially the wealthiest parts, might be culturally more comfortable as part of what Lewis and Wigen consider “North America.” So, the divisions between North and South are not clear-cut, either geographically or culturally, and it’s best to accept them as diffuse and constantly changing concepts. Furthermore, it is beyond the scope of this dissertation to

analyze the multiple ways in which we might ask Europe, Africa and Asia to fit into concepts of North and South. Nonetheless, the concepts of North and South, as I continue to define them, are convenient and will serve my purposes well.

I also believe that Lewis and Wigen's concept of African-America is fascinating and entirely neglected in the current work, mainly due to the relatively minimal African ancestry populations in the two towns—Ibarra, Ecuador and Prescott, Arizona—where I did most of my field work. Nonetheless, it must be acknowledged that a fuller and more complete picture of child-raising practices in the future should include the rich contributions, and the confoundingly complex way, in which African-America can cross the North-South divide.

A World View: Some Guiding Principles

During the course of developing the present work, I've come to adopt a few guiding principles that, I believe, bring together my cultural observations of North and South in a way that is uniting, synergistic and constructive. I realize this is a very broad place to begin, but I also find it important to make this framework clear from the start, since some of these core tenets are perhaps contrary to common notions about sustainability and its significance. I also believe that the reader deserves an insight into my worldview, and so I lay these guiding principles on the table here right from the start. That way, those who might disagree with me will at least have an understanding of where I stand,

PRINCIPLE ONE: Can we understand sustainability in a way that does not trivialize the concept?

In the last few years, the word "sustainability" is appearing with increasing frequency, in our institutions, in the media, and in our every-day discourse. It is almost always considered a positive quality, and it carries a sense of long-term stability, in a world that is changing at an increasingly rapid rate. However, I'm not sure it carries any further consistent meaning in its every-day usage. Since the

concept of sustainability forms the foundation for our Ph.D. program, I have made one of my guiding principles an attempt to decipher and use the concept in a consistent way, without trivializing it.

In a few words, I view sustainability as the path to enhanced life fulfillment, which, in turn, I see consisting of inevitably competing spiritual and economic components. Increased fulfillment at the individual or organismal level leads to enhanced population-level well-being. In chapter Two, I delve into sustainability and its greater significance in more detail.

PRINCIPLE TWO: Don't assume that anyone knows what is best for someone else.

All too often, the idea of sustainability is put forth as the Northern/Western civilization solution to what are perceived, again from a Northern/Western viewpoint, as global problems and inequities, especially ecological economic ones. However, my experience as an observer of cultural constraints suggests that the concept does not easily carry over to other cultures, and that it might better serve the culture which has invented and promoted it. In this respect, I carry a great concern that it is just another in a long list of ways that Western hubris has allowed Northern countries to assume they know how to best colonize, “develop” and organize the economies and ecologies where other people live, especially in the South. U.S. culture has carried this hubris to an insidious pinnacle where an unspoken assumption is that all cultures of the world will, through universal recognition of the value of money and capital, want to emulate the U.S. economic, social and political model. The best analogy is with the “Borg” from *Star Trek: The Next Generation*. This huge flying cube-city navigates the universe and wherever a new culture is encountered, rather than being conquered, it is assimilated into a combined organic-digital machine, by means of digital prosthetic devices that are installed in all individuals. The motto of the Borg, their message to each new culture is: “Resistance is futile. You *will* be assimilated.”

Does this mean that I, as a Southerner by roots, know what is best? I fear that the process of getting my Ph.D. degree in the United States, laden with its heavy load of obviously Western cultural precepts, might lead me to think this; that I am, in effect becoming ‘assimilated.’ And so, I have tried to

adopt, as one of my guiding principles, to never assume that anyone knows what is best for someone else. Child-raising and education should be a *cooperative* process, not a *co-opting* one.

PRINCIPLE THREE: Humans form an integral part of the ecology/economy. The cultural/social landscape is inseparable from the physical/biological landscape.

For many years I have struggled with understanding the mainstream environmental movement, despite obtaining my undergraduate degree in “Natural Resource” Engineering and working for a long period of time in a private cloud forest ecological reserve. I believe that the concept of conserving so-called natural areas is a peculiarly Western cultural idea. It is embedded in the roots of Western culture and in Judeo-Christian thought and action, perhaps even attributable to the particular demands of the desert climates of the Biblical lands (Wilson, 1991). However, I cannot understand how a “natural” area can be considered as something distinct from ourselves, from we who, as humans, by the very act of naming it, give it validity and make it part of who we are (Sarmiento, 2003). The concept of a “natural” area that needs to be conserved quickly breaks down when people’s own immediate necessities, perceived or real, are at stake. In Chapter Three, I present a framework for integrating ecology and economic worldviews with more details, including some definitions related to natural history, social/economic history, conservation and the human role in nature.

PRINCIPLE FOUR: Embrace Change: Everything, including us, evolves.

The idea that change is inevitable should make it easier to accept that we might *not* know what is best for others (Principle 2), and that we *are* an integral part of the total ecology/economy (Principle 3). Of course we can contribute to that change, but we cannot define a perfect end-point since it doesn’t exist. We must first embrace the change, and then decide how we might best contribute (Principle 5).

PRINCIPLE FIVE: Family is First. “Don’t interfere with true love.”

I don’t mean this in the trivial sense that we shouldn’t let work, or studies (our Ph.D. program) or other obligations affect our family life. Of course we should—the fact is that our families are why we do

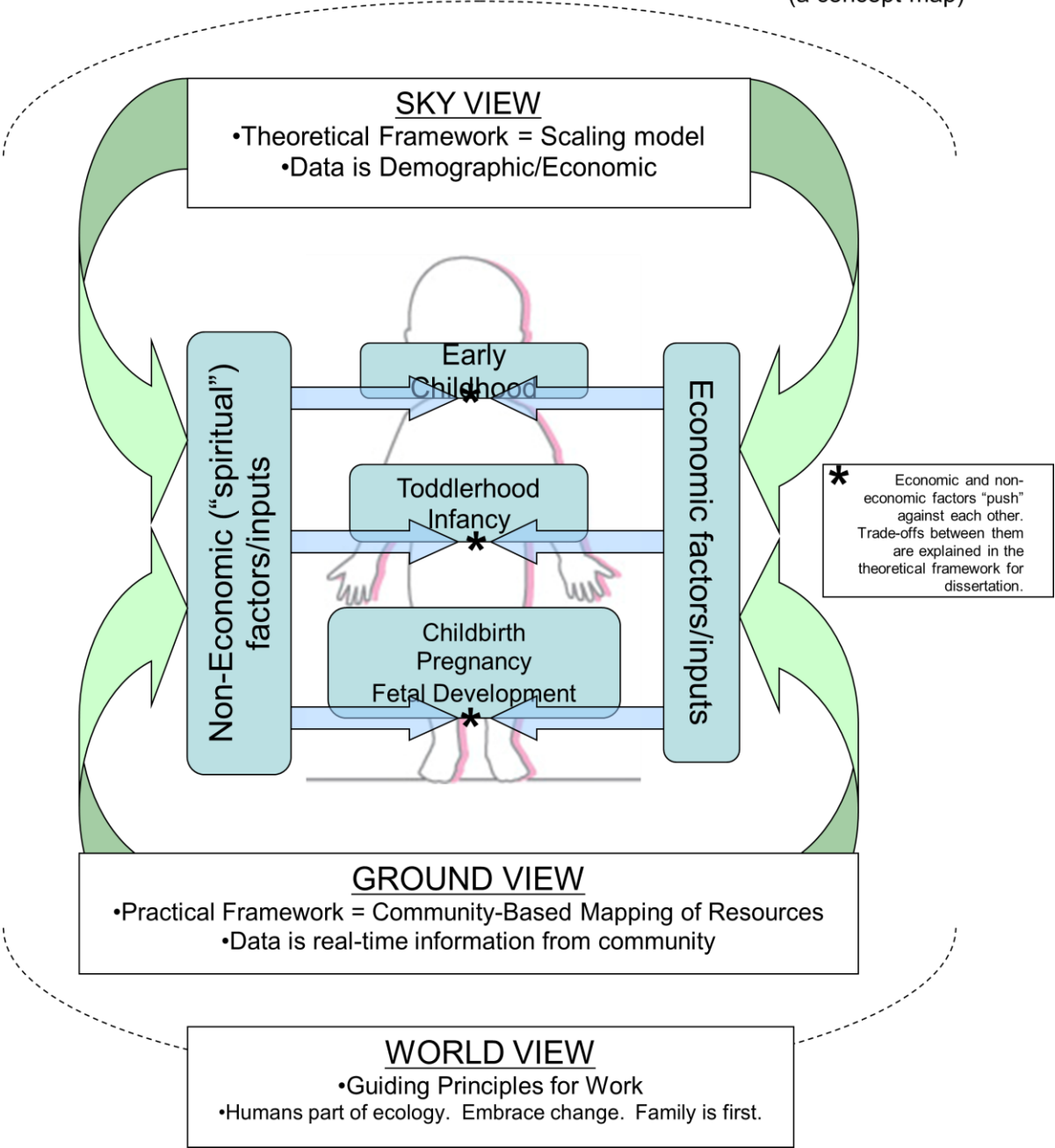
battle, why we struggle to better ourselves, why we want the most from the world around us. And I certainly don't mean "true love" in the romantic "love-at-first-sight" sense, although this might sometimes be included. Part of me would like to define this principle in strictly biological terms—we are instinctually driven to defend our genetic heritage and insure that our reproductive efforts are as successful as possible. And so, no matter what, our family comes first (even as we neglect them to amass more material wealth?). Whereas I do see some validity in the idea that "our genes make us do it," I also am guided by a higher, or spiritual, principle here. Family, for me, means those with whom we share our love. And love, in the sense of spiritual connection, is what is inviolable here.

One of the animated shows that my kids like is called "The Fairy Odd-Parents," about a boy, Timmy Turner, who has two Fairy Godparents who grant any wish that he wants. He is an only child, has all the "stuff" of a typical middle-class U.S. kid, and his own parents are parodies of Western, middle-class parent-hood, absurdly neglectful and self-serving. Anything that Timmy thinks he wants, he can wish for and it will be granted by his Fairy GodParents, giving that Western illusion that we can control it all and know what is best for everyone. Along with the shrill voices of most of the characters, I generally find the show objectionable, although if viewed as a total parody (which I sometimes suspect is how the creators also view it), it becomes rather amusing. There is, however, one thing I genuinely like about the show, which is that the Fairy GodParents are guided by a single principle under which they *cannot* grant a wish: *the wish cannot interfere with true love*. It's almost as if the show is acknowledging, despite this Northern/Western illusion of absolute control via granted wishes, that true love, in the end, is what rules the universe.

CONCEPT MAP FOR DISSERTATION

On an infinite digital canvas, each element will expand into further explanation of the elements from which it is composed

How to Maximize Fulfillment and Wise Power Use in the Start of a New Human Life
(a concept map)



CHAPTER ONE: Introduction—Energy, Power, Money and Spirit.

Economics, Ecology and Human Reproduction

$P = E/t$ *Power (P) equals Energy (E) over Time (t)*

Like all living beings, we humans cycle energy, or use power. And like all living beings, one of our key uses of power—in fact arguably *the* key use of power—is to create and raise our offspring.

Surprisingly, then, the two disciplines that are dedicated to analyzing how living beings maximize power use—ecology and economics—rarely focus on human reproduction and the care of children.

The reasons for this neglect are numerous and various. First and foremost might be the simple fact that child-raising is a personal topic, and a heart-felt one at that. Economics, famously the “dismal science,” is notoriously impersonal, cold-hearted and sometimes downright cruel. Isn’t it sufficiently inhumane to apply the cold hard facts of economic decision-making to a topic like provisioning food, especially when faced with a hungry world? But worse yet, perhaps unthinkable, is to apply the same economic approach to decisions about child-care and the quality of life...yes, even the mortality...of infants, babies and children. (Although, interestingly Thomas Carlyle, who coined the term “dismal science”, and his Victorian era counterparts, viewed the market system as “dismal” since it might allow lower classes, and even “inferior” races to obtain material equality; they were not particularly concerned about economics and markets being cold or unfeeling—see Levy, 2001 for an in-depth treatment of this perspective.) Ecologists also tend to reduce population dynamics to sheer numbers, sometimes forgetting the harsh realities of life and death that govern those numbers. Just as Adam Smith’s (1776) unfeeling “Invisible Hand” guides the realities of a market, Darwin’s (1859) equally a-moral Natural Selection, sometimes “red in tooth and claw,” guides the realities of population dynamics. Perhaps it is just too scary, too “cold-blooded,” to apply these famous laws of economics and ecology to something as warm, fuzzy and heart-felt, as raising a child. However, it’s important to recognize that the popular understanding of both Smith and Darwin sometimes reduce their great ideas to dark parodies where fierce

and unyielding competition is the only rule that applies (Gopnik, 2010; Hofstadter, 1992). The reality of their great thinking is far more subtle and includes an appreciation of high levels of cooperation within competitive economic and ecological systems—more on this later.

Secondly, a robust approach to analyzing the maximal use of power in child-raising requires the integration of economics and ecology in a way that is rarely attempted. Once we understand reproduction as the prime directive of living systems, and once we understand money as a place-holder for energy, then the differences between ecology and economics become strictly semantic (see Chapter Three for an elaboration of this integration). And by extension, the differences between human ecologies/economies and those of other living beings disappear. Odum (1996) has long argued that we must integrate the notion of real “embodied energy” or what has been coined as “emergy,” in our understanding of ecosystem and economic cycling of energy, represented financially as money in the economic realm. This integration, on the one hand, frightens us as a final step towards admitting that human consciousness carries no special privilege in the face of a universe guided by the physical laws of energy and matter. On the other hand, this same integration might be our only hope to save ourselves from ourselves, or at least to mitigate the effects of cycling booms and catastrophes, on every level, that are an inevitable consequence of the complexity that arises in self-propagating systems like life (see Chapter Two for a more detailed look at cycles of complexity, catastrophe and renewal).

Finally, the conclusions that we might confront in an economic/ecological analysis of human reproduction and child-raising carry the risk of running contrary to much of the accepted wisdom in these two disciplines. And here we return to the first point, that child-raising is a very personal, and heart-felt process. As such, it always includes a spiritual component which, although difficult to measure using joules or dollars, carries an energetic charge. I’m not referring here to a “new-age” indefinable spiritual energy (although this might be included), but rather to the simple fact that attention to spiritual matters will inevitably require the cycling of real energy, or perhaps the expenditure of real dollars. Neither economics, nor ecology, has an explicit way of addressing these spiritual costs, but when their reality is brought to the forefront, as in the case of child-raising, it carries the potential to drastically alter the

conclusions—and even the basic tenets—of both disciplines. In economics, Keynes’ “animal spirits” (Akerlof & Shiller, 2009) are seen as a last-resort explanation for understanding individual and population behavior whereas in ecology “emergent properties” (Edson et al., 1981; Marten, 2001; Salt, 1979) are often cited when the data can’t be understood in some other more “rational” way. However, when these spiritual elements—call them what you will—are brought directly into the mix, understanding *can* be ciphared out, but only by sacrificing some of the hardest-won fundamentals of the discipline.

Posing the Question: What should we maximize, and how should we do it, when starting a new human life?

The fundamental question I propose to address, then, is perhaps best understood initially as an economic one: how should we wisely use resources, as represented by power, in raising a child, or starting a new human life? However, although the question is fundamentally economic, our response must inevitably be ecological and spiritual. Ecological because economics is inseparable from ecology and, when appropriately postured they are, in fact, the same science (again, see Chapter Three for a deeper explanation of this union). Spiritual because the wise use of power is predicated on maximizing well-being, which, in turn, is always influenced by a trade-off between economic wealth and spiritual richness (see Chapter Four for a deeper discussion of spiritual and economic trade-offs in power use).

The roots of my interest in this question come from a lifelong personal and professional fascination with how parents raise their children. I have had the good fortune to experience, first-hand, vast cultural differences in child-raising practices, in part through my own family’s chosen path, and also professionally throughout my student and teacher career. I’ve leveraged this personal and professional experience into the development of a theoretical framework for trying to understand some of the ironies and conundrums that emerge as I compare and contrast the differences between North and South approaches to child-raising. For instance, why do families with less economic resources tend to have more children? Why do children from economically wealthier families tend to have more psychological problems? Why do parents with less economic wealth tend to spend more real time with their children?

And why do economically wealthier families tend to look for rational and financial solutions while economically poorer families tend to look for spiritual solutions to their child-raising dilemmas?

I realize that my question is a very personal one that affects everyone, since we've all been, at some point, children being raised by parents, and many of us are, or have, raised our own children. A plethora of advice literature, usually written on a very personal level, contains direct instructions for parents (Brazelton & Greenspan, 2000; Nabhan & Trimble, 1994; Small, 2001; Sherlock, 2003; Weil, 2003). Some of this literature might draw on existent population studies, but often it is anecdotal and driven by individual problems with specific solutions. Rarely is a population comparison approach taken for analyzing, from an economic and ecological perspective, why children are raised the way they are, at least in humans. For other animals (and plants), the ecological literature includes volumes of data on the ecology of offspring care and the use of resources for raising offspring (de Jong & Klinkhamer, 2005; Johnstone & Hind, 2006). In the economic literature, consumption, or supply and demand choices, are often analyzed for humans (Heilbroner & Thurow, 1998), but with little regard for the biology and ecology of parents raising their offspring. Recognizing that the question itself opens up huge areas of academic discourse, I expect to bridge the economics-ecology gap and the economics-spirituality trade-off in a simple way: by identifying and then focusing, keenly and finely, on specific economic and lifestyle (or ecological) factors that are the principal determinants of how parents raise their children.

The question I ask carries grand significance for improving people's overall life fulfillment; and thereby our well-being as a species. Families from across the economic spectrum and from vastly different cultural and geographic backgrounds should find my information interesting and my thesis compelling. By bringing a serious economic/ecological analysis to the question of how power and resources are used by families raising children, I circumvent the biased and culturally constrained advice that is typically available. This analysis, instead, will look at the real economic/ecological consequences, and advantages, of family circumstances. At the same time, by recognizing that traditional economics must be considered within an ecological and spiritual context, I avoid a strict financially-based analysis

that fails to account for the spiritual richness inherent in certain resources, approaches, or uses of power in raising children.

Maximizing Fulfillment in Starting a New Human Life

Traditional economic analyses emphasize the maximal use of resources to promote growth. However, as the “sustainability movement” has taken root and inserted itself widely into human discourse, the primacy of promoting and pursuing growth in economic systems has come into question. At the same time, a clear idea of what would replace growth—or what *sustainability* might mean for an economic system—is, at best, poorly defined, and at times highly contentious. Thus, to proceed, we need an in-depth treatment of *what* exactly *we* want to maximize in the use of power for child-raising, and *who* exactly wants to maximize it.

CHAPTER TWO—Is Sustainability What We Want? And *Who* Are We?

We are told that the trouble with Modern Man is that he has been trying to detach himself from nature. He sits in the topmost tiers of polymer, glass, and steel, dangling his pulsing legs, surveying at a distance the writhing life of the planet. In this scenario, Man comes on as a stupendous lethal force, and the earth is pictured as something delicate, like rising bubbles on the surface of a country pond, or flights of fragile birds.

But it is illusion to think that there is anything fragile about the life of the earth surely this is the toughest membrane imaginable in the universe, opaque to probability, impermeable to death. We are the delicate part, transient and vulnerable as cilia. Nor is it a new thing for man to invent an existence that he imagines to be above the rest of life; this has been his most consistent intellectual exertion down the millennia. As illusion, it has never worked out to his satisfaction in the past, any more than it does today. Man is embedded in nature.

--Lewis Thomas (1974), *The Lives of a Cell*

A disclaimer

I have found myself confronting the concept of sustainability, almost continuously, throughout my student and professional life. After five years pursuing my undergraduate degree in Natural Resource Engineering, ten years of experience working on sustainable development and conservation projects, and even a short stint on the faculty of a master's degree program in Community Management of Natural Resources where environmental, social and economic sustainability formed a fundamental paradigm for the course of study, I was still not sure if I understood the concept. Extensive reading and discussion on the topic from two cultural and economic perspectives—the Northern and Southern views (North and South as defined culturally in Chapter One)—has only helped to convince me that I'm far from a simple understanding of what sustainability means. I can recall a low point where a half-day workshop in Ecuador devolved into a heated discussion over which Spanish translation for sustainability is more appropriate: “*sustentabilidad*” from the noun “*el sustento*” which is what sustains a person, usually referring to their daily nutrition; or “*sostenibilidad*” from the verb “*sostener*” which means to maintain or sustain and has a reflexive form “*sostenerse*” which is to support or maintain oneself. This semantic distinction was grounds for a heated discussion over whether sustainability refers to individuals sustaining

themselves, to a society being sustained (and if so, by what?), or simply the need of all living beings for basic nutrition.

I am quite sure that the central premise for my thesis—the quest for balance between physical wealth and spiritual richness—can be easily enveloped within many typical understandings of what “sustainability” is. However, I am equally certain that the wide-ranging of definitions for the term means we should use it sparingly and carefully, and if possible avoid it, even at the cost of verbosity. Part of my reluctance about the term sustainability emerges from a great cultural divide, between North and South, in its understanding. What follows is an attempt to de-construct some aspects of sustainability, but if a clear, or at least succinct, definition is what the reader seeks, this will not be the place to find it.

Growth and Sustainability

Growth is a fundamental feature of living systems at all levels of the biological and economic hierarchy, from cells to ecosystems. Open any introductory biology text-book, and among the first chapters, you will find “growth” listed as one of the defining features of life. At the same time, it is axiomatic that growth has limits. Bacteria in a Petri dish run out of nutrients, rabbits quickly fill up their hutches, and Piñon forests expand to a boundary where the physical environment places physiological limits on tree growth. Human population and economic growth also have limits, and this fact forms the basis for many approaches to sustainability, including the seminal *Limits to Growth* (Meadows et al., 2004) which models world-wide human resource use and its potential future pathways.

The premise of *Limits to Growth* frames, in its essentials, the problem that “sustainability” wants to solve: when the limit to growth is passed, how will self-regulation— another fundamental feature of living systems—come about? Will self-regulation happen through a gradual process of carefully measured adjustments? Or will it come about through complete collapse or catastrophe? Some proponents of sustainability quest after a path to gradual adjustment. They often propose maintaining certain levels and types of growth without reaching collapse, through what is generally referred to as “sustainable development.” (Dasgupta, 2007; Pezzey and Toman, 2002).

In 1987, Gro Harlem Brundtland, then prime minister of Norway, provided what is often cited as the seminal definition: “Sustainable development is development that meets the needs of the present without comprising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987).” From this broadly reaching idea has emerged a “sustainability revolution” (Edwards, 2005) that has refined thinking and promoted certain ways of trying to insure a sustainable future. Allen et al. (2003) suggest that we should always ask about sustainability: “Of what, for whom, for how long, and at what cost?” They go on to present two extremes: one where we sustain nothing because we cannot place any value on what future people will need; and another where we cannot foresee future values so we must preserve everything (p.25). They point out that these extreme perspectives are probably paralyzing since they preclude rational action; instead Allen et al. (2003) resolve the extremes by finding a middle road where “the things we want to sustain have only the values we assign to them” (p. 25). The difficulty, of course, with this middle road, is finding a way to assign value, and we are confronted with the paucity of hard data that analyzes the real ecological effects of trying to develop “sustainable” systems. Gut-level assumptions that, for example, less consumption is always better, may not always be the best way to avoid collapse, if this is in fact the goal of sustainability.

Woodbridge (2004) argues that the sustainable development movement tries to do too much:

“The international agenda must be squeezed down from all the things that *can* be done to promote growth, and that *could* be done in the name of social equity, to the few things that *must* be done to greatly increase the availability of ecological goods and services that will make possible continued growth and the pursuit of social equity. The simply stated objective of finding ways to provision societies with access to natural capital without further impairing the operation of global ecosystems must be made the great political challenge of our times.” (p. 10).

He says we must allow for growth, that inevitable feature of biological systems, without increasing environmental damage, and that this goal requires mobilization on the scale of a World War, a war where a united humanity battles ecological decline. He sees this as the only way to avoid disastrous ecological degradation, or what he calls “flips” in the self-regulating features of environmental systems.

Again, however, we are presented with the difficult dilemma of deciding what kind of ecological decline might lead to “flips” and what the resultant human suffering might be. Woodbridge provides few

real examples. We are left, then, two decades into the sustainability movement, still wondering what we should sustain, how we should sustain it, and for whom?

Collapse and Sustainability

The archaeological record tells us that human societies *have* collapsed in the past. We can see their ruins, where nobody lives today, on Easter Island, in Egypt, in Viking Greenland, in Mayan Central America, in the Incan Andes and many other parts of the world. Jared Diamond (2004) analyzes a number of different historical collapses from an environmental viewpoint and finds some common denominators for societies that experience collapse: overuse of resources, lack of flexibility in social systems especially regarding environmental resource use, and a top-heavy social structure where increasingly wealthy and non-productive upper classes are heavy resource consumers.

Diamond admits that it is almost impossible to identify when or where collapse is imminent, or actually happening. Are parts of today's world not already in collapse, and which parts would that be: Sub-Saharan African and "Third-World" urban shanty-towns, or perhaps North American and European suburban "bedroom communities?" Is it possible to identify collapse while it is happening, or will it look like some continuum that begins with a gradual declining quality of life? And is collapse always to be avoided? Do present-day Mayan descendants live higher or lower quality lives than their pyramid-inhabiting predecessors? Or was the collapse of their societal and governing structure actually a way out of the immediate suffering brought about by the threat of human sacrifice? Was collapse for the political and religious leaders actually relief for the peasants, or perhaps for upper classes as well? In short, does collapse always bring about more suffering? And how can we measure suffering? In order to make sense of collapse and its potential for causing a decrease in well-being, or an increase in human suffering, we need to examine how, if possible, we would define and identify collapse. And then consider who the collapse might affect.

Cycles of Complexity and Collapse

Self-regulating interconnected entities tend to move towards increasing complexity (Capra, 1997; Homer Dixon, 2006). For living systems, this can be observed during the lifetime of a cell, as it gains additional metabolic capacities, among a colony or group of cells as they interact in more sophisticated ways with the environment, during the fetal and subsequent development of a multi-celled organism like ourselves, throughout the succession of an ecosystem, in the build-up of human economies and civilizations, and as historical evolution proceeds through the vast expanses of geological time, with the appearance of ever-more-complex major groups. However, this tendency towards complexity is marked by cycles of relatively abrupt retrenching into a simpler form, something that from a human perspective can often appear as catastrophic collapse, especially when it happens in our own environment, at our own spatial level; and in particular within our own economies and civilizations (Homer Dixon, 2006). For the cell, retrenching is the moment of mitosis or spore formation, for the organism the moment of meiosis and fertilization, for the climax ecosystem the aftermath of a fire or infestation, and for historical evolution the mass extinction. Defining collapse for human economies and civilizations is tricky at best, although we seem to recognize it well after the fact in historical analyses of classic cases like Easter Island, the Vikings, Rome, Inca, Maya, Khmer and others. What inevitably follows retrenching or collapse is a period of renewal, regeneration, invention and revitalization; these cycles may be an often-overlooked fundamental feature of autopoietic, self-regulating systems and of life itself at every level (Capra, 1997). Growth in living systems is not simple increase in size, but rather comes accompanied by the gradual establishment of increasing levels of complexity. The pace at which complexity and new invention appear may be accelerated following collapse.

What is the significance of these fundamental cycles of collapse and regeneration to our notions of sustainability? Intuitively, collapse is identified as something to be avoided at all costs. But if collapse is an inevitable feature of living systems, how can it be avoided? Should we, or *can* we, look for a softer collapse? And softer for whom? Or should we welcome collapse for the regenerative spark that often follows?

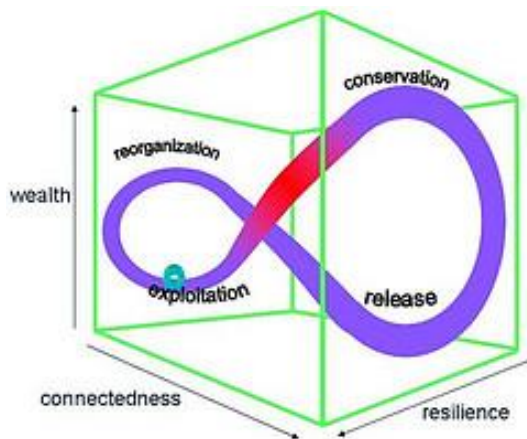


Figure 1. Holling's (2001, 2004) panarchy of cycles for complex systems like ecosystems or human economic systems. The cycles occur in three dimensions of wealth, connectedness and resilience. As complexity increases, the system becomes wealthier, more connected, but less resilient until it falls into a cycle of release and then reorganizes into a cycle of exploitation that enters, once again a period of increasing complexity and wealth.

In *The Upside of Down*, Thomas Homer Dixon (2006) musters a book-length argument about the potential for renewal that is inherent even in collapse of great civilizations, using Rome as a constant reference point. He builds on the work of Holling (2001, 2004; Gunderson & Holling, 2002) to argue that cycles within cycles, or the concept of panarchy (Figure One), are an intrinsic and even welcome feature of living systems. Even the classic paradigm of a stable ecosystem—the climax primary forest—is probably better understood as a system that has reached a peak of complexity; the continual augment of that complexity inevitably creates vulnerabilities in the system such that some disturbance—fire, infestation, or human intervention—will bring a drastic (catastrophic from the environmentalist perspective) reduction in complexity as the dominant tree species are eliminated or have their populations significantly reduced (Dorren & Berger, 2006). However, the aftermath of these “catastrophic” events is inevitably a regeneration, re-birth, and re-invention of the eco-system, sometimes leading, through succession, to an equally, or even more robust, climax forest. In the U.S., the aftermath of the Great Yellowstone Fires of 1988, which environmentalists predicted would be something like a nuclear wasteland, surprised everyone (Pyne, 2004). The beautiful diversity of meadows, wildflowers and

regenerative eco-systems attracted hordes of visitors and the forest quickly moved into a cycle of impressive regeneration and high heterogeneity of the ecosystem (Schoennagel & Smithwick, 2008).

Homer Dixon (2006) makes a strong argument, by analogy, for similar processes in the build-up and fall of human civilizations.

The *Upside of Down* (Homer Dixon, 2006) is most interesting, however, for its veiled sub-plot, which is the avoidance of catastrophic events for human civilization, or at least for the current world. Here is where Homer Dixon reveals, between the lines, the ultimate, or perhaps unrecognized and even unconscious, motives of the sustainability movement. After a book-length treatment that encourages us to accept “collapse” and to celebrate its potential, especially for the lesser (lower energy-use?) species in a non-human eco-system, or the lesser (also lower energy-use?) classes in a human economy, Homer Dixon concludes the book analyzing where the weak points in the current global economy/eco-system lie, and how we might ameliorate their potential for collapse. One is left wondering why this ultimate analysis? Is it because, in keeping with the *modus operandi* of the sustainability movement, what we are looking for, what Homer-Dixon hopes to achieve through his analysis, is avoiding the loss of *status quo* for the dominant class?

The relationship between the build-up of complexity, moments of retrenching or collapse, and subsequent regeneration of complexity are not well-defined and are, at best, difficult to study, particularly for human economies since we cannot easily put them under the microscope or subject them to experimental manipulation. Thus, for the dominant complexity class (read high-economic-level, consumerist, geographically Northern and culturally Western populations of people), sustainability can sometimes be understood as code for avoiding the loss of dominance and power—i.e., the leveling of the complexity and resource playing field—that might accompany collapse. On the other hand, the current level of energy cycling, or power use, which this class needs solely to defend the complexity of individual lifestyles, may not bring about higher levels of life fulfillment, or increased well-being for the species or the population. In fact, the very collapse that is feared might bring about a more wholesome and fulfilled life for themselves (ourselves?) and offspring. Change can be painful, and loss of power accompanying

change even more painful, but as *The Prophet* (Gibran, 1923) says, “Your pain is the breaking of the shell that encloses your understanding.” A lifelong response to managing complexity and high levels of individual power use traps the consumerist North “first world” populations on a blind treadmill where they pursue their lifestyle under the guise of “choice” while in reality are driven (or perhaps constrained) by biological constants related to growth and the accompanying tendency towards increasing complexity. The very collapse that this class fears may be their own salvation to a less energy-powerful, but more spiritually enriched life.

Huge social inequities are also frequently identified as contributors to the risk for collapse, and seen as contrary to the ideals of sustainability (Heilbroner & Thurow, 1998; Homer Dixon, 2006). Here, the discontent of under-classes may be exacerbated by exaggerated spreads of wealth distribution. In general, as a country’s average income increases, the absolute disparity between richest and poorest usually increases as well (Rothman & de Bruyn, 1998). In fact, to make the income gap narrow as average incomes increase, the top income brackets must undergo significantly lower percentage gains—or even percentage losses—since their absolute income increase at any given percentage is much greater than the lower income brackets (Acemoglu & Robinson, 2002).

However, again, it is hard to predict how collapse or a rapid loss of complexity will affect the economically poor. On the one hand, for the 20 percent or more of human populations that subsist, often with hunger, on a day-to-day basis, it is hard to imagine a harsher reality. Collapse might be welcome relief and the “leveling of the field” might open new opportunities for those geographic and demographic sectors that are currently closed out of any non-metabolic power use and accompanying lifestyle complexities. On the other hand, as the power-accustomed consumerist classes defend their resources during a period of retrenchment, the economically poor are likely to be even more deprived of resources.

If we bring into play the possibility that even collapse may not be detrimental over the long run, and that furthermore we can’t easily predict its effect based on economic or complexity class, then is the entire notion of sustainability, and the entire sustainability movement, without credibility, pursuing a “silver lining” (i.e., environmental harmony, social justice, economic equity, or any other popular

sustainability-component-of-the-week) to jackets worn by “straw-men” (i.e., suffering of the under-class, extinction of species, environmental scourge, or any other salvation-of-the-week-cause)?

Resolving Sustainability and Collapse—two key questions emerge

Two key questions emerge from our analysis of sustainability and collapse. One is relatively simple, and also beyond the scope of our current project: are there some kinds of collapse that are clearly to be avoided given their extraordinarily negative toll? This question has some quick and obvious potential answers: nuclear war, massive crop failure and widespread global famine, devastating pandemic disease. However, can we predict when and where these disgraces might fall, and whom they might most affect? Probably not, but our answer to the second question might help reduce their likelihood. The second question is an on-going one that we must confront directly in our quest to maximize resource use for child-raising: how, whether it is during times of increasing complexity or during entrenchment and collapse, do we seek high levels of individual fulfillment (spiritual as much as economic) and greater levels of population well-being? And for whom do we seek these benefits? How can we know who is in the right place, living the right way, at the right time, to lead a fulfilled life that minimizes suffering and maximizes well-being? If we strive towards addressing this question, then I believe we strive towards sustainability in the best sense of the word. A framework for addressing the questions emerges in the next chapters as we examine how to integrate ecology and economics, and as we look at how economic wealth can detract from spiritual richness.

CHAPTER THREE: Four Authors and Seven Simple Truths—the integration of ecology and economics and the confrontation between physical and spiritual energy

If we are to arrive at a system for analyzing the wise use of power in the start of a new human life, then the time has come to lay on the table our best efforts towards integrating ecology and economics. Profound inspiration from four brilliantly eloquent authors has inspired my understanding of how ecologies and economies are the same conceptual entity. I use inspiration from these four authors to succinctly define a series of key terms that I then use in proposing “Seven Simple Truths” about power use in economic/ecological systems.

The basic concepts expressed in this chapter form the theoretical foundation for my analysis of power use in child-raising. As an environmental scientist and biologist, I’ve become fascinated with how the economist’s way of understanding the world can be extended to provide us with some core “truths” that apply to living systems in general. What I’ve tried to do here is reduce those core understandings to some simple, universal phrases that can guide is in analyzing the use of power at different scales in complex ecological/economic systems.

I’ve been very influenced by five different authors. Herman Daly, whose text *Ecological Economics* (with Josh Farley, 2004), is considered the founding work for the field of the same name opened my mind to the value of economic thinking in general, even if I don’t always find that the ecological economist has created a valid framework for understanding. Nonetheless, this text has formed a backbone for my thinking about the role of power in ecological and economic systems. Four other authors have provided more in-depth insights into various aspects of economics, power and scale: James Baldwin, Carl Sauer, Michael Pollan and Geerat Vermeij.

On first glance, these four authors from disparate disciplines, times and places might seem marginally related to each other and the task at hand. However, each one has a deep and universal message related to the use of power alongside the long, mostly Western, divorce of human individuals and populations from the environment. By using their wisdom to confront what might be deeply internalized thinking, or

prejudices, regarding ourselves, our place in the world, and the meaning of power, I hope to bring about a welcoming mindset for a much simpler view of how ecologies and economies operate. Intrinsic to this mindset is the notion that humans are fully biological beings, that vernacular understanding of power is always equivalent to the physicist's understanding, and that spirituality has a power-based underpinning.

I use these authors' insights to define a number of terms that are commonly used in economic and ecological analysis. By carefully defining these key terms, I aim to show that my use conforms with some aspects of their vernacular understanding. At the same time, I also recognize the inspiration of these authors to be careful about removing humans from the environment—that is to separate “nature” from “culture” or economics from ecology. Here, Fausto Sarmiento (2001, 2003) and his development of the concept of sacred cultural landscapes, has also been a deep inspiration.

Finally, in the last section of the chapter, I put forth Seven Simple Truths that I hope capture the core concepts that I've taken away from thinking about our economic relationship with nature and the union of economics and ecology. I find that *power*, in its many different understandings, is crucial and the *scale* on which power is used may be what ultimately determines how we improve the quality of our lives.

Because I worry that my attempt to explain these concepts might remain in the realm of the esoteric or theoretical, and also because I enjoy thinking about food and where it comes from, I've tried to illustrate each phrase with a focus on how it relates to food and agriculture.

Four Authors

I present each of these four authors with one or two lengthy quotes from their work. I apologize for not reducing their ideas more, but I find each of them so eloquent that I feel it is necessary to present the essence of what they say in a larger context framed by their own words. The quotes I've chosen have surfaced powerfully and almost with a life of their own in reference to my thinking about scale, power and sustainability. Key phrases from each author, highlighted in bold, capture the core of their message that is essential to my later presentation of Seven Simple Truths.

James Baldwin

James Baldwin, who died in 1984, was a Harlem Renaissance and Civil Rights era writer who spent much of his later life as an expatriate living in France. Early on he made his fame writing deeply and movingly about the religious and spiritual upbringing in the Black church. Later he wrote equally insightfully about the white/Black tension and its roots. Without condemning whites, he consistently recognized that the problem in racial relationships stems from a spiritual void in the ruling, mostly white, class worldwide. He believed that the only solution was for whites to find self-dignity and an inner spirituality that might allow for sharing of power in a truly liberating way (for whites). It would be fascinating to have Baldwin alive today and able to share his views on the sustainability movement. In his own time, his point of view was perhaps never fully appreciated by the civil rights movement. More importantly, his lessons are not unique to white/Black racial tension in the United States, but universal to power-wielding classes everywhere. Here is what he says in *The Fire Next Time*:

White Americans find it as difficult as white people elsewhere do to divest themselves of the notion that they are in possession of some intrinsic value that black people need, or want. And this assumption—which, for example, makes the solution to the Negro problem depend on the speed with which Negroes accept and adopt white standards—is revealed in all kinds of striking ways, from Bobby Kennedy’s assurance that a Negro can become President in forty years to the unfortunate tone of warm congratulation with which so many liberals address their Negro equals. It is the Negro, of course, who is presumed to have become equal—an achievement that not only proves the comforting fact that perseverance has no color but also overwhelmingly corroborates the white man’s sense of his own value. Alas, this value can scarcely be corroborated in any other way; there is certainly little enough in the white man’s public or private life that one should desire to imitate. White men, at the bottom of their hearts, know this. Therefore, a vast amount of the energy that goes into what we call the Negro problem is produced by the white man’s profound desire not to be judged by those who are not white, not to be seen as he is, and at the same time a vast amount of the white anguish is rooted in the white man’s equally profound need to be seen as he is, to be released from the tyranny of his mirror. All of us know, whether or not we are able to admit it, that mirrors can only lie, that death by drowning is all that awaits one there. It is for this reason that love is so desperately sought and so cunningly avoided. **Love takes off the masks that we fear we cannot live without and know we cannot live within. I use the word “love” here not merely in the personal sense but as a state of grace—not in the infantile American sense of being happy but in the tough and universal sense of quest and daring and growth.** And I submit, then, that the racial tensions that menace Americans today have little to do with real antipathy—on the contrary, indeed—and are involved only symbolically with color. These tensions are rooted in the very same depths as those from which love springs, or murder. The white man’s unadmitted—and apparently, to him, unspeakable—private fears and longings are projected onto the Negro. The only way he can be released from the Negro’s tyrannical power over him is to consent, in effect, to become black himself, to

become a part of that suffering and dancing country that he now watches wistfully from the heights of his lonely power and, armed with spiritual traveler's checks, visits surreptitiously after dark. How can one respect, let alone adopt, the values of a people who do not, on any level whatever, live the way they say they do, or the way they say they should? I cannot accept the proposition that the four-hundred-year travail of the American Negro should result merely in his attainment of the present level of the American civilization. **I am far from convinced that being released from the African witch doctor was worthwhile if I am now—in order to support the moral contradictions and the spiritual aridity of my life—expected to become dependent on the American psychiatrist. It is a bargain I refuse. The only thing white people have that black people need, or should want, is power—and no one holds power forever. White people cannot, in the generality, be taken as models of how to live. Rather, the white man is himself in sore need of new standards, which will release him from his confusion and place him once again in fruitful communion with the depths of his own being.**

--James Baldwin (1962), *The Fire Next Time*, pp. 127-130.

Carl Sauer

Carl Sauer was an early 20th century academic geographer credited with crystallizing the area or discipline of cultural geography. His life research was devoted mainly to understanding the domestication of plants, especially in the Americas. He traveled and researched extensively in Mexico and also South and Central America. He used a very subjective and narrative approach to his studies which today might be considered “participatory” or “community-based.” He believed some of the richest information would come from non-academic, rural, farmers who conserved cultural customs and knew their crops’ as a full-cycle living entity with a rich history. He also incorporated archaeological evidence and believed that geography has a crucial historical or fourth-dimension component. Here are some quotes from *Seeds, Spades, Hearths and Herds*:

The geographer, therefore, properly is engaged in charting the distribution over the earth of the arts and artifacts of man, to learn whence they came and how they spread, what their contexts are in cultural and physical environments.

We are dealing in large part with observations of the present that originated in a past which does not come again, or which cannot be verified experimentally. We may, in fact, both as to nature and culture, be making reconstructions of past scenes and acts greatly different from what is now. We use the testimony of eye witnesses if we can find such, and also whatever circumstantial evidence that can be brought to bear on the reconstruction. **Time, changing in tempo and usually non-recurrent as to mode, spreads a veil we can never fully lift. Yet, if we are trying to learn about the changing, man-inhabited world, human geography must take the risks of interpreting the meeting of natural history and cultural history and that, perhaps is as much of a definition as we need. Our problems have four dimensions and we cannot simplify them by, or as, academic abstractions.**

I like that expression, the meeting of natural and cultural history, partly because I prefer natural history with its sense of real, non-duplicated time and place to ecology, and cultural history for the same reason to sociology or social science. The things with which we are concerned are

changing continuously and without end, and they take place, for good reason, not anywhere, but somewhere, that is in actual situations or places.

-Carl Sauer (1952), *Seeds, Spades, Hearths and Herds*, pp. 1-2

Man alone ate of the fruit of the Tree of Knowledge and thereby began to acquire and transmit learning, or “culture.” With each new skill he found in his surroundings more opportunity or “resources” to fashion products of use to himself, to improve his well-being, and to increase his numbers. **An environment can only be described in terms of the knowledge and preferences of the occupying persons: “natural resources” are in fact cultural appraisals.** Occasionally, a new idea arose in some group and became a skill and institution. Such innovation might bring out new possibilities of the homeland: it might also give competitive advantage over neighboring folk, and set in motion pressures eased by migration.

There is no general law of progress that all mankind follows: there are no general successions of learning, no states of culture, through which all people tend to pass. There have been progressive cultures and others that show almost no signs of change. The latter are to be found in areas of high isolation: the former have been favored by the nature and location of their homelands. **The parallel to biologic evolution is significant. Invention begins by small increments of insight, variant ideas that gain acceptance under a favorable cultural climate. Variation follows on variation and may build up into a significantly new way and view of life. Now and then, in a few and, I may repeat, physically favored areas some such center has burst forth into a great period of significant invention, from which ideas spread, and in part changed as they spread afield. These centers of major and sustained innovation were always few. In the history of man, unless I misread it greatly, diffusion of ideas from a few hearths has been the rule: independent and parallel invention the exception.**

-Carl Sauer (1952), *Seeds, Spades, Hearths and Herds*, pp. 2-3

Michael Pollan

Michael Pollan is a journalistic writer who has been interested recently in the human relationship with nature, initially in constructing a home and then, very insightfully, in how we choose and obtain the food that we eat. His book, *The Omnivore's Dilemma: A Natural History of Four Meals* (2006) analyzes how the food we eat gets to our plate and the process by which it gets there while *The Botany of Desire*, (2001) looks at the domestication of four crop plants—Apples, Tulips, Marijuana and Potatoes—from the plant's perspective. The premise for this book, eloquently expressed in the introduction, does what a great journalistic writer can do so well—it takes the scientist's assumptions and turns them on their head in a way that makes sense and is easily accessible and understandable. He begins the book by comparing our role in the garden to a bumble bee's. He then goes on:

This book's broader subject is the complex reciprocal relationship between the human and natural world, which I approach from a somewhat unconventional angle. **I take seriously the plant's point of view.** ...

Plants are so unlike people that it's very difficult for us to appreciate their complexity and sophistication. Yet plants have been evolving much, much longer than we have, have been inventing new strategies for survival and perfecting their designs for so long that to say that one of us is the more "advanced" really depends on how you define that term, on what "advances" you value. Naturally we value abilities such as consciousness, toolmaking, and language, if only because these have been the destinations of our own evolutionary journey thus far. Plants have traveled all that distance and then some—they've just traveled in a different direction.

Plants are nature's alchemists, expert at transforming water, soil, and light into an array of precious substances, many of them beyond the ability of human beings to conceive, much less manufacture. ...A great many of the chemicals plants produce are designed by natural selection, to compel other creatures to leave them alone: deadly poisons, foul flavors, toxins to confound the minds of predators. But many other of the substances plants make have exactly the opposite effect, drawing other creatures to them by stirring and gratifying their desires....

The one big thing plants can't do is move, or, to be more precise, locomote. Plants can't escape the creatures that prey on them; they also can't change location or extend their range without help.

And so, about a hundred million years ago plants stumbled on a way—actually a few thousand different ways—of getting animals to carry them, and their genes, here and there. This was the evolutionary watershed associated with the advent of the angiosperms, an extraordinary new class of plants that made showy flowers and formed large seeds that other species were induced to disseminate. Plants began evolving burrs that attach to animal fur like Velcro, flowers that seduce honeybees in order to powder their thighs with pollen, and acorns that squirrels obligingly taxi from one forest to another, bury, and then, just often enough, forget to eat.

About ten thousand years ago, the world witnessed a second flowering of plant diversity that we would come to call, somewhat self-centeredly, "the invention of agriculture." **A group of angiosperms refined their basic put-the-animals-to-work strategy to take advantage of one particular animal that had evolved not only to move freely around the earth, but to think and trade complicated thoughts. These plants hit on a remarkably clever strategy: getting us to move and think for them. Now came edible grasses (such as wheat and corn) that incited humans to cut down vast forest to make more room for them; flowers whose beauty would transfix whole cultures; plants so compelling and useful and tasty they would inspire human beings to seed, transport, extol, and even write books about them.** This is one of those books.

So am I suggesting that the plants made me do it? Only in the sense that the flower "makes" the bee pay it a visit. Evolution doesn't depend on will or intention to work; it is, almost by definition, an unconscious, unwilling process. All it requires are beings compelled, as all plants and animals are, to make more of themselves by whatever means trial and error present. Sometimes an adaptive trait is so clever it appears purposeful: the ant that "cultivates" its own gardens of edible fungus, for instance, or the pitcher plant that "convinces" a fly it's a piece of rotting meat. But such traits are clever only in retrospect. Design in nature is but a concatenation of accidents, culled by natural selection until the result is so beautiful or effective as to seem a miracle of purpose.

By the same token, we're prone to overestimate our own agency in nature. Many of the activities humans like to think they undertake for their own good purposes—inventing agriculture, outlawing certain plants, writing books in praise of others—are mere contingencies as far as nature is concerned. **Our desires are simply more grist for evolution's mill, no different from a change in the weather: peril for some species, an opportunity for others. Our grammar might teach us to divide the world into active subjects and passive objects, but in a coevolutionary relationship every subject is also an object, every object a subject. That's why it makes just as much sense to think of agriculture as something the grasses did to people as a way to conquer the trees.**

--Michael Pollan (2001), *The Botany of Desire*, pp. xvi-xxi

Geerat Vermeij

Finally, Geerat Vermeij is an invertebrate paleontologist and world-class expert on the evolution of mollusks (clams and snails). He has spent most of his working academic career in U.S. universities and has gained a reputation as an insightfully creative (maverick?) evolutionary theorist. He is also blind from birth (no more excuses about how much we have to read—every bit of text he takes in must be read to him as he takes notes in Braille!). His most recent book, *Nature: An Economic History*, tries to explain all ecological systems—even all living systems—within the framework of economic understanding. Notice how carefully Vermeij uses language to include human economic systems within a larger understanding of the economy of nature. He basically eliminates the “us and them” nature-culture divide:

Yes, we are very powerful, and we can do things no other living things on Earth can do; but, I shall argue, our enormous power and reach have not allowed us to conduct economic life with rules fundamentally different from those that apply to living things generally. The differences are real, but they are differences in amount and scale, not in kind. In effect, economic ideas apply to an enormous diversity of systems, of which ours lies at one extreme of a continuum. **In so many words, this chapter is an invitation to human-centered readers to learn about the rest of life, and to naturalists to think about human society and history in biological terms.**

--Geerat Vermeij (2004), *Nature: An Economic History*, p. 39.

Although we usually think of the word *economy* in such human terms as trade, profits, markets, and finance, it applies just as aptly to the systems of which living things other than humans are constituents and architects...An economy is a collective whole, a system of metabolizing, interacting, smaller units or entities that are themselves economies. The constituent units adapt to, and bring about changes in, their environment as they compete locally for energy and material resources. **Economies are built on living things, which complete cycles of work by coupling chemical transformations that alternately use and release energy in the context of an architecturally and organizationally constrained physical structure.** Economies thus have knowable properties not possessed by any one of their individual members. The work of life—growth, replication, and activity—creates meaning and information and ultimately leads to a history in which self-interested parties who cooperate to fashion larger wholes give rise to and replace each other. Evolution—descent with modification—is thus an expected and universal historical process in economic systems. It occurs because economic units compete locally for resources, and because only those entities that acquire and retain the necessities of life in the face of such competition and of uncertainty persist. Cooperation among economic players reduces rivalry at one level, but creates more potent competitors on a larger scale. **Trade and cooperation (or mutual exploitation) thus lead through self-organization, or co-construction, to regulation of resource supply and consumption, and to complex interdependencies that emerge as the common good for the larger economy and for many of its constituents, especially for those that wield disproportionate power.**

--Geerat Vermeij (2004), *Nature: An Economic History*, pp. 1-2

How should performance be measured? Economic entities succeed or fail through competition for energy (the product of force and distance, expressed in joules) and its material equivalents. It is energy that entities exchange during interactions. Energy is therefore a currency, or means of exchange, for valuing economic activity. In the monetized economy, money substitutes for energy. Money acts as a means of valuing resources; we buy and sell goods and services with it, but money does no economic work by itself. Economic activity, however, is not just about energy; it is also about time. Being first in the market with a product can be more important than being the best; the risks of injury or death can be minimized by quick action. The appropriate measure of performance is therefore power, expressed in watts, and defined as energy (or work) per unit of time.

Power as a measure of performance and money or energy as a measure of exchange are obviously linked. Price—the amount of money paid or received for goods and services—is determined by the rate of production or supply (productivity), the rate of consumption (demand), and the extent to which producers and consumers control information about these rates. Producers, for example, may know more about (or have greater influence over) the market than do consumers, and may often be in the position of creating demand by advertising. Price is thus determined by power, even if we pay it only in units of money or energy. Price integrates availability, use, risk, and information as these relate to buyer and seller.

It is well known that rates are extremely sensitive to the amount of time over which they are measured. Just as phenomena vary in space, they vary through time. The longer the interval over which a rate is measured, the more this small-scale temporal variation is integrated and smoothed out. In other words, information is lost as the interval over which rates are calculated lengthens. Fluctuations in price depend in part on how often critical information about supply and demand is assessed. **Power and price measured over the long run will not be the same as power and price calculated in the short term. The calculations used should match the time scale or lifespans of the entities whose performance is being measured. This issue of compatibility of time scale has rarely been raised in the economic works I have consulted.**

Measuring economic performance in units of power will strike many economists and biologists as peculiar and unfamiliar. The reasons for this unease arise from common word usage. **The word power as employed in everyday speech refers to influence, control, the implied or actual use of force, or the imposition of the will of one party on others. Whether this power is used or only implied, it is based on power in the strict physical sense, as energy per unit time. I shall therefore use the word power throughout this book in both the strict physical meaning and, to my mind equivalently, in the more metaphorical sense familiar to politicians, historians, and sociologists.** Furthermore, each discipline has its own jargon for power as a measure of performance. **To economists performance is usually expressed as profit.** In the currency of money, profit can be employed to enrich the producer, to reinvest in the producing firm, to fund new ventures either by the firm itself or by its investors, or to be redistributed as tax by the state for the real or perceived public purpose. **To ecologists, performance is measured as net productivity, the power beyond that needed for subsistence. The excess thus becomes available for growth, reproduction, or consumption. Evolutionary biologists are accustomed to fitness as a measure of performance. Fitness in this technical sense means the surplus of power devoted to offspring. This reproductive power can be allocated either to large numbers of poorly provisioned young or to a few offspring that receive extensive parental care or investment. All three terms—profit, net productivity, and fitness—are special cases of power. The details of measurement vary according to discipline and context, but energy and time are integral to all measures of performance.**

--Geerat Vermeij (2004), *Nature: An Economic History*, pp. 22-23

Some terminology

Inspired by these authors, I define a number of terms that are commonly used in ecological and economic analyses, many of which can have multiple meanings, and some of which even carry a huge scale (this will be one of the words) of reference across disciplines from the most reductionist physical science approach to a most inclusive or holistic spiritual approach. I'm not trying to sell my definitions as the best, but just want to be sure that I might be consistent, at least in the way I myself use these terms. By providing what are succinct, yet rich, definitions, for these key terms, I hope to establish a usable vocabulary for looking at our economic relationship with nature, or what might be better termed "the economy of nature." This initial attempt at uniting ecological and economic approaches eliminates the assumption that we, as humans, hold a special place outside the natural world; or that we will always be the subject with nature the object. For some terms, I've referred to the authors above, and for others I've amplified my own perspective.

Environment: The popular press, and the environmentalist movement, is especially focused on "saving the planet" or "saving a particular ecosystem" in their portrayal of "environmental" issues. This involves a presumption that we, as humans, are somehow not an acting economic entity, or integral part, of that environment. If we can conceive of an environment, then do we not, by proxy, form part of it?

Natural resources: As Sauer, again, says, "natural resources are cultural appraisals." The implication is that the divide between us and them, between humans and nature is non-existent, or that it exists only to the extent that we are able to consciously put a name to the energy and matter that we cycle through our economies, whereas we assume most other living species just do this cycling without ever naming the "resources." This is not to say that the ability to name something as a resource doesn't give us, as humans, a special ability. However, we must be careful not to believe that because we can name it, we somehow become the owner of the resource. The same set of complicated cycles, in part determined by the contingencies of history, will govern the elements in the environment that we culturally appraise as

resources. A perfectly reductionist economic analysis will not allow for full understanding of the resource and we need an appreciation of ecological complexity, and multiple levels of interaction among complex entities, to complete the cultural appraisal of a particular environmental element, or a “natural” resource. We also need an appreciation of the *history* of our own, as well as the general ecological/economic system’s, interaction with the resource or element in question.

Natural history and ecology: Vermeij points out, as Sauer did fifty years earlier, that ecology has moved in the direction of emulating the reductionist “hard” sciences. Ecologists often describe current environmental relationships and then construct experiments without taking natural history into account. Ecosystems, as well as economies, have a history and ecology must be a historical science. Sarmiento (2001) has elegantly shown how both the natural and cultural history of a region, with special emphasis on the tropical Andes—of special interest to me as well—must be considered when doing biodiversity and ecosystem analyses.

Cultural history and sociology plus economics: Here, Sauer also argues for treating human cultural relationships as “four dimensional” with the discreet contingent events of history playing an important role. Obviously, this has been a great academic tradition, in the discipline of history itself, as well as in anthropology and archaeology. However, again human ecologists and sociologists (and especially economists) often look for a reductionist, structural explanation for how human economies work. But historical factors must play an important, if not crucial and determining, role. The tropical Andes, again, are a classic case study for the importance of considering human history in analyzing landscapes that are difficult to even categorize as agricultural or wild; where human “intervention” is part of the long history of the land (Sarmiento, 2002; Sarmiento & Frolich, 2002). Even today, the new Ecuadorian government, via its “*revolución ciudadana*,” is promoting “*el buen vivir*”—literally “the good life” as an ecological and societal imperative. The new Ecuadorian constitution even includes inherent rights for the natural world (Cardenas, 2010).

Energy: Physicists have a very elegant reductionist understanding of energy and its famous relationship to matter ($E=MC^2$). Energy, in the form of heat, measured as calories, is indestructible, which forms the basis for the Second Law of Thermodynamics. Economists use this idea to look at how production and consumption happen by conversion, but never destruction, of energy and mass. In this respect, money is a place-holder for energy. Money itself cannot have meaning if it doesn't represent energy (or the energetic potential in a mass of material). This is a necessary, but not sufficient condition to give money meaning, since it also requires faith and confidence, or at least understanding, on the part of its users. However, even the creation of that "faith" in money probably requires the expenditure of real physical energy, or the existence of a real physical placeholder for money such as coins, notes, or digital code. Other living beings also hoard energy, usually in the form of food stores (the classic buried acorn) but also as collaborating domesticates (ant-kept fungi and termites) or built homes (beaver dams and bird nests). Plants frequently hoard energy in the structure of their organism—e.g. sap in a maple tree, tubers in the roots, endosperm in their seeds or thick succulent leaves—and humans typically take advantage of these hoarded stores of energy in our domesticate relationships with them. Animals hoard energy in their organisms as stored fat.

In living systems, and especially ourselves, we can talk about an emergent type of energy that we might call "spiritual" energy. The physical basis for this type of energy is probably shared with our understanding of heat, and other forms of energy, as conversions from mass. As such, there should inevitably be trade-offs between the collection and expenditure of physical/economic energy versus spiritual energy.

Power: Physicists and engineers understand power as the rate at which energy is used which can be measured in watts (Power equals Energy divided by Time). In economics, throughput or the flow of energy through the ecosystem is an important concept (Daly and Farley, 2004, p. 6). For Vermeij (2004—see quote above), power is the correct measure of economic performance, whether that performance is being gauged by human economists analyzing finances, ecologists analyzing the economy

of environmental-organismal interactions, or evolutionary biologists analyzing the economy of family, offspring and social structure. The only case unique to humans is financial analysis since other species don't use money as a representation of energy, although they do often store other physical representations of energy.

Well-being: Economic well-being is defined monetarily by classical economists, usually in terms of income at a micro- or family level and GNP at a macro- or ecological level (McConnell & Brue, 2005). Daly and Farley (2004) show how welfare is the basic goal of an economic system: "Without the concept of welfare or enjoyment of life, the conversion of material resources first into goods (production) and then into waste (consumption) must be seen as an end itself—a pointless one. Both conventional and ecological economics accept the psychic basis of welfare, but they differ on the extent to which manmade and natural capital contribute to it."

Daly and Farley also present some alternatives to measuring non-economic, or what perhaps should better be called non-monetary, measures of welfare (that is, if we accept Vermeij's premise that all natural systems are economies, then any measure of welfare would be economic, and classical economist's measures of welfare would have to be considered "monetary"). I particularly like Max-Neef and Elizalde's (1991, 1992) matrix of human needs that looks at an interesting variety of different values and how they relate to aspects of our existence. I wonder whether non-economic, or non-monetary aspects of well-being could just be phrased as "spiritual well-being?"

Spiritual: James Baldwin (1962) talks of the spiritual aridity of white American culture. What is spirit? Is it the emergent and transcendent qualities of living economies that cannot be easily reduced into simple measures of physical energy, at least not within the capabilities of our current brain-based and micro-chip-based computational abilities? Common sense and personal experience tells me that the spiritual will be in competition with the reducible physical and monetary economic. I think we can talk about spiritual energy, spiritual power, and spiritual well-being as important and often neglected aspects

of economies. Can we successfully quantify them and show their trade-off with monetary and physical aspects?

Domestication: As Pollan (2001) points out, domestication is really nothing more than a co-evolutionary relationship, or as Vermeij would argue, an ecological economic relationship no different than the relationships between any two organisms that share an environment. However, our vernacular use of this word carries heavy connotations of “man” as the subject and whatever is being domesticated—crops, beasts of “burden,” “woman” as the object. Yet anyone involved in a productive domestic relationship (which would include all of us) knows that it must be a two-way street and that careful attention to what the “domesticated” member says to the “domesticator” is crucial. This is true for horse-tamers, dog-trainers, spouses, gardeners, farmers, parents, and anyone who wants to see their “domesticates” thrive. In fact, superlatively productive gardeners, farmers and animal-raisers usually anthropomorphize the species they live with and learn to understand their language.

Scale: Although it often gets used this way, scale is not simply size. Size is, as we all know, how big something is. Scale is the relationship between how big something is and some other factor. For example, how does energy use *scale* with the *size* of the house? Scale is always about the relationship between two or more factors. In biology, engineering, and many other disciplines, well-developed mathematical/statistical tools—principally correlation analysis—help define scaling relationships (Allen & Holling, 2002; Brown & Moses, 2003;).

Five different aspects of scale are important in understanding the way in which ecological/economic entities perceive and respond to the environment (after Vermeij, 2004):

- Physical size—length, area, volume or mass.
- Reach—distance, area or volume traversed by a mobile entity
- Number—number of units or a measure of population
- Duration—length of time of an event or lifespan

- Frequency—number of events or units per unit of time or lifespan

In striving to appreciate the wise use of power in raising children, every one of these aspects carries a potentially important, if not crucial, role at the level of the individual family as well across populations of families.

The role of power and scale in human and natural economies—7 simple truths

To capture the essence of how ecology and economics integrate into an elegant explanatory model for analyzing maximal power use (including the spiritual component), I've used my understanding of the above terms to develop "Seven Simple Truths" about our economic relationship with nature and how it informs us about the use of power on different scales. *Power*, in its many different understandings, is central to this integration, while the *scale* on which power is used may be the key determinant for improving the quality of life, which is what I believe to be at the core of "sustainability."

I worry that, without a concrete example, my attempt to explain these concepts might remain in the realm of the esoteric or theoretical. At the same time, I don't want to pre-judge any ultimate conclusions about the use of power in child-raising, by pushing foregone conclusions into what is so far a theoretical framework. Therefore, for several different reasons, I've chosen to use food and agriculture as a source of examples to illustrate each of the truths. First of all, since eating is a daily experience for all of us, it holds the promise to provide intuitive expressions of the "truths" I am proposing. Secondly, on a personal level, I've chosen food examples because I am interested...I like to eat...and who doesn't! And finally, given my rural agricultural roots, I hold a lifelong fascination with farming and food production that makes it easy for me to analyze food and its production within this context.

However, by no means are my "Simple Truths" limited to explaining food provisioning. The conceptual scheme inherent in the Truths applies equally to the provisioning of just about any other "commodity" or "need" including shelter, clothing, education (or information), health care, communication, and transportation, all of which are important elements of human reproduction and the raising of a child.

These seven phrases form what I hope is a logical progression starting from what are very solid and exact representations of economic/ecological concepts and leading into more open-ended ideas about how we can understand the special role of power.

I. As living entities, we cycle energy, a process that we can call “power use.”

A typical 60 kg human has a metabolism that uses energy at a rate equivalent to a bright light bulb or about 130 watts. Of course this rate of energy use varies by the minute and hour as we go from highs when we exercise or write conceptually difficult theses to lows when we meditate or relax. Sleep is not always low power use and would show a lesser but not insignificant range of power use. These short-term variations in power use would not extend beyond one or two orders of magnitude. Daily or weekly measures of power use would show even less variability.

The typical human diet of about 2500 calories daily provides the energy for this metabolic use of power.

II. Variation in power use across living systems is huge.

Tiny single-celled organisms use very little power whereas larger warm-blooded mammals use relatively huge amounts of power. Among humans, when non-metabolic energy is considered, the range of power use extends across many orders of magnitude, with peak per capita power use in developing countries reaching tens of thousands of watts per individual (Moses and Brown, 2003). This additional “non-metabolic” power use is provided principally by fossil fuels.

The 2500 calories of energy in a typical human daily diet comes directly from the carbohydrates, proteins and fats in the plants and animals that we eat. However, in “developed” countries and economies, provisioning that 2500 calories—growing and transporting it—involves thousands of calories of fossil fuel subsidies. The amount of fossil fuel input will vary tremendously depending on the particular food item and how it is provisioned. Home vegetable garden products may have little or almost

no fossil fuel subsidy, although this depends greatly on how the garden is managed. Factory-raised animal products transported long distances may have very high fossil fuel subsidies.

III. The scale of power use greatly affects how organisms use resources and, how they interact with the environment... or how economies behave.

Just about any quantitative or qualitative ecological measurement will be affected by the scale of power use. In some cases, these affects may be universal. For instance, greater power use is closely correlated with reduced fertility (Moses and Brown, 2003). Other aspects of power use may be historical contingencies that might even deviate from an otherwise tight correlation; thus, the importance of always considering natural and cultural history (as Sauer defines them) in economic and ecological analyses. For instance, probably due to close proximity to fossil fuel power sources (and the wealth they provide), some Middle Eastern countries show high fertility rates in spite of high power use (normally high power use countries have very low fertility).

Extreme contributions of fossil fuel energy to food production and distribution may be a North American phenomenon related to the vast heartland breadbasket geography. However, urbanization world-wide, regardless of cultural constraints, leads to heavier fossil fuel contribution, and thus higher power use, in food provisioning. The local cultural basis for diet, especially what staples form the diet base, may greatly affect this pattern.

IV. (Natural) Selection operates when different approaches to power use result in better performance

Following Vermeij, economists measure performance as profit, ecologists as net productivity, and evolutionary biologists as reproductive fitness. Better performance in any of these areas might result in a more viable economic entity, be it a “natural” organismal, populational or ecological entity, or a human economic/financial entity, although that increased viability may be transient depending on environmental change. Darwin is rightly credited with applying the great idea of natural selection to explain how species

evolve, but he almost consistently used human-domesticate examples to show how short-term dramatic change can come about through selection.

In the sustainability paradigm, “food security” is often presented as an ideal measure of performance. It is an interesting concept that incorporates both the economist’s financial profit measure as well as an ecologist’s net productivity measure of performance. Solutions to food provisioning and increases in production are often provided by power-use heavy sectors of the economy. Green revolution technologies and the forced distribution of famine relief supplies show the success of power intensive agricultural production in terms of short-term selective forces. However, non-economic, or “spiritual” measures of fulfillment or well-being (see Chapter Four) may require recognition of local cultural base for diet and the long-term selective advantage may go to lower power use approaches, such as how gardening can provide “food security.”

V. Economic well-being is based on better performance in cycling of energy or money.

High power use economic systems have shown, at least in recent historical time, a great selective advantage. Higher profits result in greater ability to store and cycle energy, or its representation as money.

The ability to buy food can be stored as money. And to some extent, the food itself can be stored using power-dependent technologies such as refrigerators, cans, nitrogen-rooms, etc. However, despite these abilities, high power-use humans may also tend towards storing food energy in their own organism as accumulated fat reserves. Obesity should scale with high economic performance (profit well-being) related to food provisioning. The trade-off with non-economic or spiritual well-being may explain morbid or health-detrimental obesity.

VI. Physical and political power currently depends on economic well-being, or faster cycling of energy and money leading to great financial profit.

Political power in today’s world scales with the ability to cycle resources and energy, or economic well-being. This correlation may be a universal feature of living systems and, in fact, the two

types of power may stem from the same source. However, scale is very important, as are non-economic, or at least non-financial, measures of power and well-being. Parts of the money-supply may no longer represent real material or energy present in the natural world. According to classical economists, this might not matter since information and technology should be limitless and this may be what some part of the money supply represents. However, Daly and Farley (2004) suggest that information does have a cost and will not necessarily always increase:

“It is a gross prejudice to think that the future will always know more than the past. Every new generation is born totally ignorant, and just as we are always only one failed harvest away from starvation, we are also always only one failed generational transfer of knowledge away from darkest ignorance.” (p. 41)

It may also be that as long as people are psychologically prepared to accept the value of money for its own sake, then it does not matter whether it represents any real energy in the physical world. However, common sense would suggest that the greater the supply of non-representational money, the less likely that people will psychologically accept its value. At some point, the non-financial measures of well-being may lead people to reject an inherent value for money. We see this happen when people return to barter systems, or when economies collapse.

Green Revolution agriculture uses energy inputs to increase production by faster cycling of energy. More power input results in greater production output. Eventually, however, the nutritional value of the product may not be increased, even if its weight or quantity is. Again, lower power use production may produce a “spiritually” and nutritionally more satisfying product.

VII. Non-economic well-being is based on better spiritual performance

As accumulation of wealth allows for increasing power use, overall well-being may decline. Daly and Farley (2004) show how, past approximately 1950, increases in U.S. per capita GNP and family income have not correlated with overall increases in life satisfaction. In fact, in recent times, overall satisfaction in monetarily rich Northern countries and regions has declined despite continued increases in

financial measures of performance. This suggests that once economic necessities are met, non-economic cycling of energy or spiritual power may be a more important contributor to overall well-being.

Most sustainability efforts have focused on reducing economic power use among wealthy and perhaps sustainably developing more power use, or at least greater access to power, among the poor. However, these efforts assume that reducing economic power use will come as a sacrifice. As Baldwin points out, though, the only thing repressed people want is power, and they may not want it on the same economic terms. Increased overall life fulfillment for individuals, and well-being among the population as a whole, might only be possible when the financially wealthy classes are convinced that they could (should?) unconditionally surrender their economic power and replace it with an even greater value of non-economic or spiritual power—the path to enlightenment!

The modern supermarket may be a classic demonstration of this effect. At some point, the number of products to choose from, and the vast fossil fuel subsidy to their production and distribution, detract from the actual nutritional and spiritual satisfaction that their culinary potential might represent. We see this today with a movement, among spiritually thoughtful individuals, towards local food provisioning and the recognition that freshness and ease of access may be a key component of a healthy and fulfilling diet (Heron and Waters, 2008). Perhaps one of the most satisfying ways to achieve more spiritual well-being from the food we eat is re-establishing the co-evolutionary domesticate relationship in our homes, perhaps by growing a vegetable garden or keeping chickens. The reality of provisioning billions of people means that mass agricultural production will be a long-term necessity. However, home food production may alleviate some of the loss of spiritual well-being that accompanies provisioning through strictly financial arrangements, thereby bringing a much needed cultural and spiritual basis back to the diet.

Two challenges emerge—reifying spiritual energy and analyzing the scale of power use

As we move into an analysis of power use in child-raising, these Seven Simple Truths form a frame of reference to guide us when it appears that personal, perhaps prejudicial, pre-conceived notions prevent

distilling truth from the data. This framework should allow using the tools of economics and ecology in a way that confronts the sustainability question, or that truly analyzes how to bring about higher quality of life for individuals (in the form of economic and spiritual fulfillment) and populations (in the form of higher average well-being). Two important challenges emerge from this integrated ecological/economic framework.

The first is a call for reifying the notion of spiritual energy. It is one thing to boldly assert that spiritual and physical energy somehow present a trade-off. Or even more boldly, that spiritual energy is always represented by a physical reality that can be measured in energetic terms. However, the challenge, to be addressed in the next chapter (Chapter Four), is to at least put some parameters and some examples to this bold assertion.

The second challenge is related to the importance of scale in economics and ecology. For the dependent entities that live within particular ecologies or economies, the scale of the system and its components is the single-most important factor that determines their power use and its effect on quality of life. Scaling analyses are common in ecology and in economics. They are principally used to try and establish fundamental relationships between the size of a particular component and its behavior. However, rarely is thought and consideration given to where, on the scale, an ideal point lies. This is where our appreciation of the dynamics of power use, and an attempt to cipher out physical and spiritual power, can guide us. In Chapter Five, we'll look at some examples of how scaling analysis can be interpreted within the framework of wise power use with the goal of determining what scale and type of power use might best lend itself to improved sustainability—life fulfillment and well-being—in the start of a new human life.

CHAPTER FOUR: Spiritual Energy--it doesn't have to be mystical anymore.

The basics of Energy, Time and Power

In the course of integrating an ecological and an economic approach to power use, I have defined a conflict or competition between physical and spiritual energy. But what is meant by spiritual energy and can it be distinguished from physical energy?

Recall that

$$\text{Power (P)} = \text{Energy (E)} / \text{Time (t)}$$

Improved performance in a complex system is equivalent by to an increase in power. Vermeij (2004) argues that in economic systems, performance can be understood as profit, in ecosystems as net productivity, and in evolutionary systems as reproductive fitness. Furthermore, he argues that there is no substantive difference between the three measures of performance, except that in economic systems, money can be used as a place-holder for energy in the power equation. In general, economic, ecological and evolutionary systems move towards increasing performance, although this is not a continuous upward trend but one that can be marked by cycles of lower performance, and sometimes even periods of catastrophic reduction in performance and complexity (Hollings, 2001, concept of panarchies), as discussed in Chapter Two.

The basic power equation gives us two ways to increase power use. One is by increasing the amount of *energy* that is being cycled and the other is to decrease the *time* over which a given quantity of energy is being cycled. A robust analysis of power use in the performance of complex systems needs to consider both factors. Increases in the amount of energy that is being cycled usually accompany *growth* of the system whereas decreases in the time cycle accompany improved *efficiency* of the system. Growth and efficiency are typically considered to be absolute positives or desirable outcomes of change in the

system, especially for human economic systems (McConnell & Brue, 2005; Vermeij, 2004). Ecosystem analyses of power use also give advantage or superiority to systems that exhibit growth and efficiency (Fath et al., 2004). In evolutionary analysis of reproductive fitness, a deliberate analysis of the time frame for reproduction, in terms of what are called *r*-selection and *K*-selection strategies, recognizes that there is no intrinsic advantage to a particular time frame or level of energy input into offspring.

In *r*/*K* selection theory, different species arrive at different strategies for improving reproductive fitness (Pianka, 1970). At one extreme, *K*-adapted species invest large amounts of energy over long periods of time into relatively few offspring; thus the emphasis is on filling the carrying capacity of the ecosystem, which is what the variable *K* stands for in the classic Verhulst (1838) equation of population dynamics, inspired by Thomas Malthus. At the other extreme, *r*-adapted species produce huge numbers of offspring, into which very little energy, in the form of parental care, is invested, with the variable *r* representing the reproductive rate variable in the population.

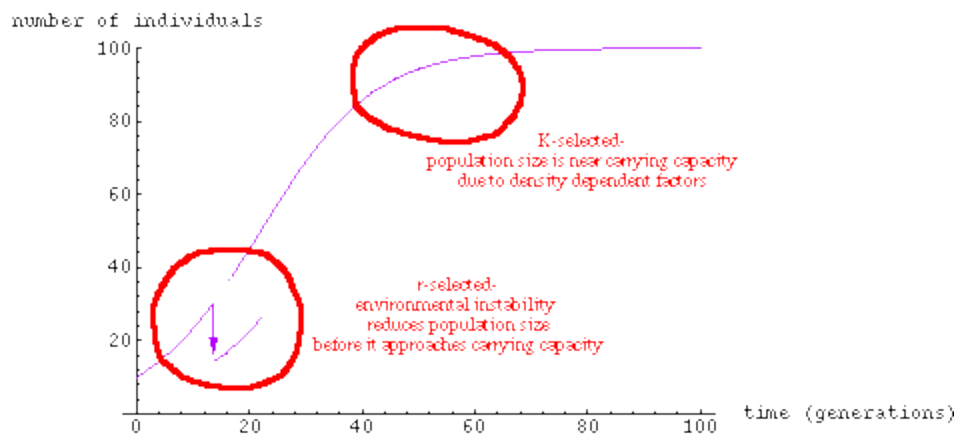


Figure Two. Time versus Number of individual offspring showing the difference between K-selected strategies and r-selected strategies. For a K species, high amounts of energy over long periods of time are invested into very few offspring. This is generally seen among larger organisms with higher individual energy needs. For r species, large numbers of offspring are produced over short time frames with very little parental energy investment. r and K strategies represent a continuum, although certain regions along the continuum might be rarely used or even prohibitive in a given ecosystem. Image is from http://www.bio.miami.edu/tom/courses/bil160/bil160goods/16_rKselection.html

Economic systems and eco-systems could be analyzed using a similar conceptual framework that accounts for varying time frame strategies, but this is rarely done. For instance, a “*r*-strategy” company that quickly produces large numbers of relatively low-cost, low-quality, unsupported products might be just as profitable (high performing) as a “*K*-strategy” company that produces high-quality, well-supported costly products over a longer time period.

Intuitive parsing of power use according to energy level and time frame

The message from *r/K* analysis is that in order to fully understand changes in performance related to power use or energy cycling, we need to take into account both energy and time variables. In order to do this, we can create a graphical space where different realms of power use are represented as the intersection between the amount of energy that is cycled and the time period over which that energy is cycled (Figure 3).

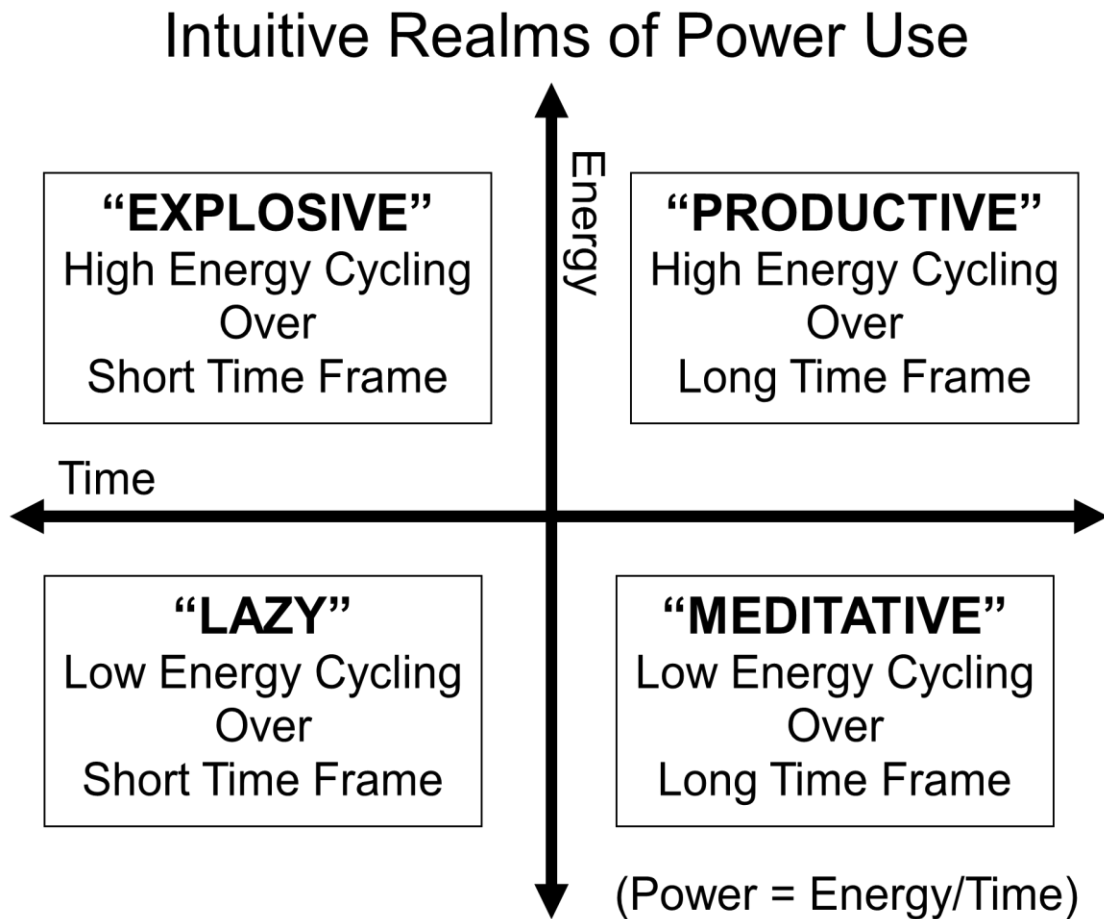


Figure 3. Intuitive realms of power use in a space represented by time and energy axes. This analysis is deliberately non-mathematical, but should help to give an intuitive sense of how changes in energy use level over different relative time periods results in different types of power use regimes.

Each quadrant intuitively represents a different realm of power use, or a different way of doing work. A given entity, or energy cyler, be it an individual organism such as a person, an ecosystem such as a forest, or an economic entity such as a business, cannot be in more than one realm, or even one exact point in the power use space at any given time.

The key question that emerges, then, is what point in the power use realm is ideal for a given activity like child-raising, or some specific aspect of child-raising? Extremes are probably to be avoided. For example, cycling high levels of energy over very short time periods results in explosive devices that

are very hard to control. Although some would argue that bombs have a very important role to play in certain circumstances, for most human activities, and certainly child-raising, they would be considered not only useless, but highly destructive. The more energy that is cycled and the shorter the time period over which it is cycled, the more destructive the device. On the other hand, extremely low energy cycling over very long periods of time probably reflects a non-living situation such as what we might find in inert solid materials. Even in the range of power use among living systems, the extremes of long-term, low-energy cycling probably are not useful for child-raising.

For human individuals and groups/societies/economies, the use of extra-metabolic energy (usually in the form of fossil fuels), often over relatively short time periods, tends to keep us in the “productive” or even “explosive” realms of power use. Intuitively, an argument could be made that “spiritual” energy cycling or power rarely involves extra-metabolic energy, and usually occurs over longer periods of time; such spiritually oriented activities—e.g., conversation, “family-time,” cooking-from-scratch, eating, prayer, meditation, communing with nature—would be found in the “meditative” or “lazy” realms. Among high extra-metabolic use populations—specifically the consumerist Northern classes—we hear frequent calls for “slowing down” to “spend quality time” in what we, at least intuitively, might consider more “spiritual” cycling of energy.

The mathematical power use space

This intuitive sense of what “spiritual power” is can serve us an initial guide. However, if we are to arrive at a more rational, mathematically-based analysis of what this “spiritual” use of power or performance might mean for child-raising, we need a more exact representation of the relationship between energy and time.

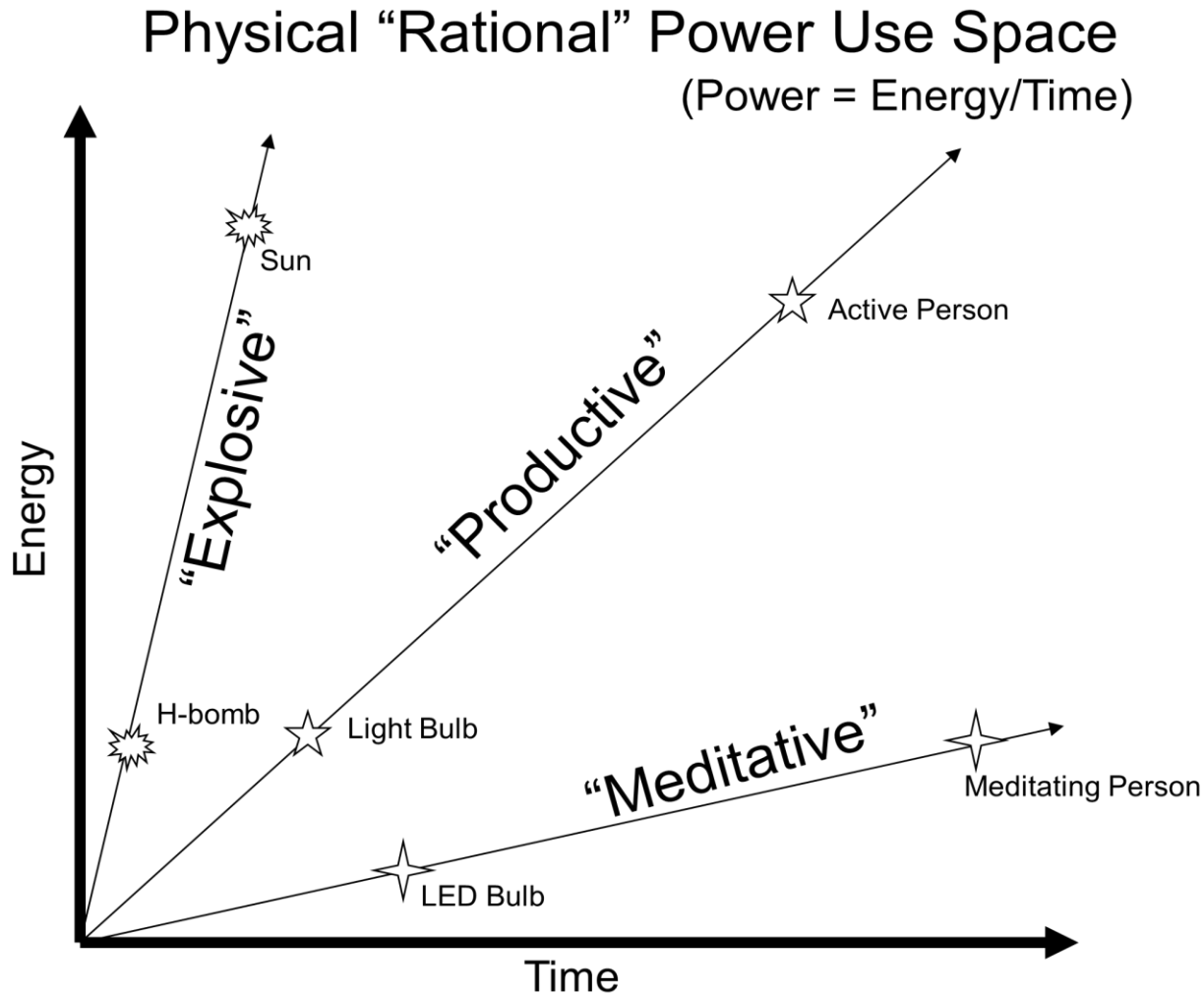


Figure 4. *The Mathematical Power Use Space.* Here, the Energy and Time axes are understood to begin at zero since negative time or energy are physical impossibilities, at least in the real world. Then, the slope of the line represents power use (as change in the y-axis over change in the x-axis or energy divided by time). The steeper the line, the higher the level of power use.

More realistically, at least from a physical/mathematical standpoint, the axes of energy and time start at zero, since negative energy and negative time are physical impossibilities (Figure 4). Within this mathematically oriented power use space, a given line represents a particular level of power use, with the slope of the line giving the level of power use. (Remember that the slope of a line is the change in the Y-variable or Energy over the change in the X-variable or Time, which is exactly how we calculate Power as Energy/Time). The location of a point along the length of the line gives the time of continuity of

power use in a given system; systems further out along the line will have, for that particular level of power use, a higher level of energy that has been cycling for a longer period of time. Thus, for example, an active person uses energy at the same rate (that is on the line of the same slope) as a 100-Watt light bulb. However, the person, with a lifespan of 70 years, is further along the line than the light bulb with a lifespan of just a few months.

Power use, as measured in Watts, is always an instantaneous (in calculus a derivative) indication of energy cycling at that moment in time ($P = dE/dt$). However, power use can also be understood (or in calculus, integrated) as the average power use over a period of time such as the lifetime of the entity being measured. Thus, an H-bomb and the Sun both fall on the exact same power use line, given their energy cycling, or power, is instantaneously derived from the same process of nuclear fission. However, the H-bomb has a very short life-time of seconds whereas the sun, much further out along the curve, has a lifetime of billions of years (Figure 4). By the same token, to repeat, a 100 Watt light bulb with a three-month lifespan will be on the same line, but closer to the origin, as a 100 Watt human (approximate average metabolic energy use) with a 70-year lifespan.

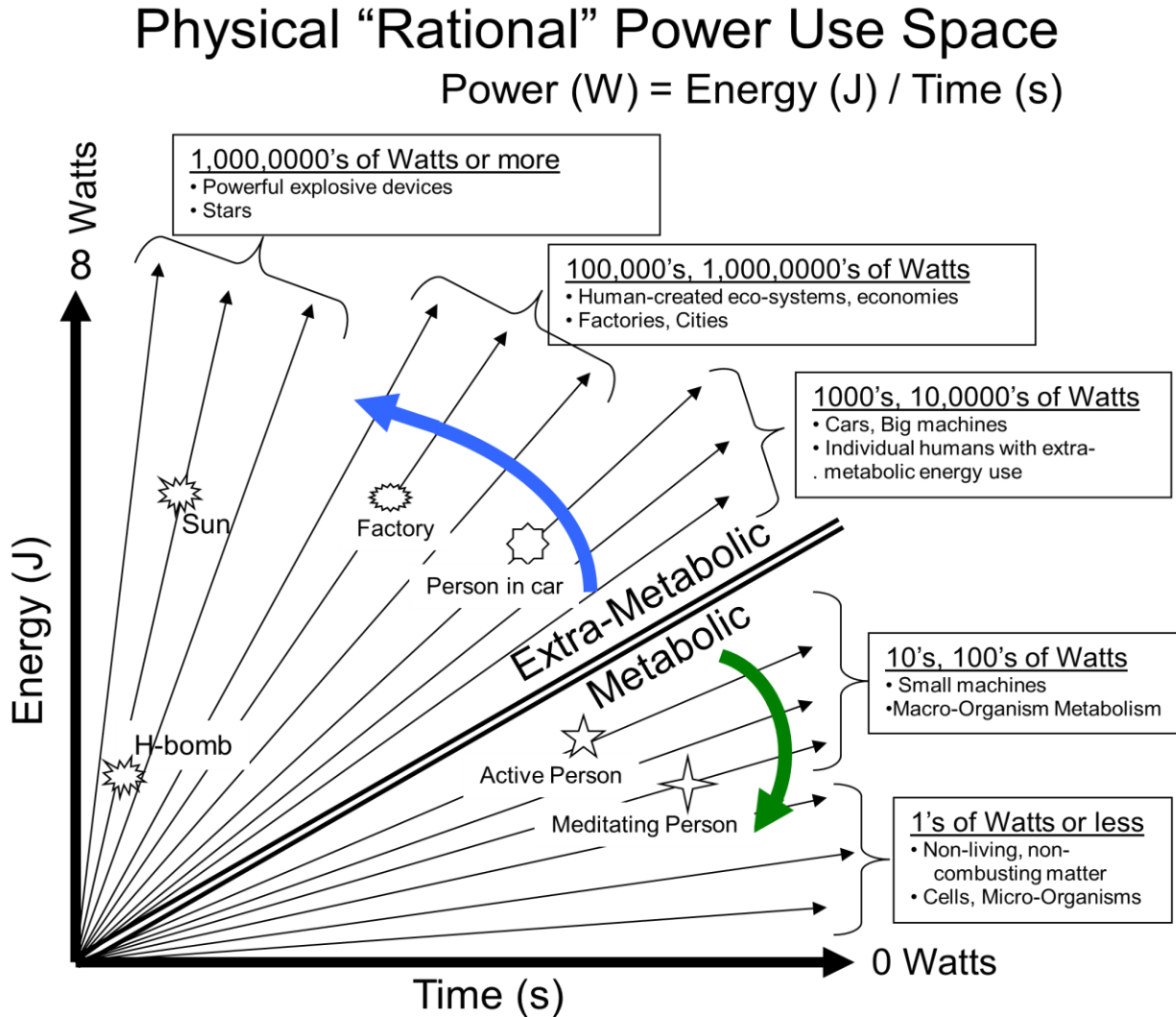


Figure 5. Another view of the power use space showing the “fan” of lines that represent all possible power use levels. Examples of different orders of magnitudes of power use, for both living and non-living systems, are given. For humans, we can divide the space into metabolic levels of power use that involve the processing of food energy in our body to do activities with our own muscles; and extra-metabolic activities that involve using energy subsidies, usually in the form of fossil fuel, to do activities that use technology.

Even more realistically, we can imagine the energy-time space, representing all the possible different levels of power use, as being filled with a fan of lines from the flat x-axis where power use in Watts would be zero (0) to the vertical axis where power use would be infinite (∞). A complex self-regulating entity, like a living cell, an individual organism, an eco-system, or an economy, can and will frequently change its level of energy cycling or power use. In mathematical terms, it will move among

lines of different slopes. However, at any given moment, a particular entity can only be on one particular line, or at one particular level of power use.

For human individuals, the cycling of extra-metabolic energy, principally derived from fossil fuels, can drastically increase the slope of the line upon which we find ourselves; in extreme cases even taking us to explosively steep slopes—in fact, unfortunately, even to the nuclear fission slope represented by the H-Bomb/Sun line. We can separate the power use space into a region of metabolic energy use where we would encounter people undertaking activities with little or no technological accompaniment; and a region of extra-metabolic power use where we would encounter people using varying levels of energy-driven technologies, usually on the basis of fossil fuel consumption.

An individual human fetus undergoing development, an infant, or a baby cannot, of its own accord, move into the extra-metabolic power use space, or get above the line that separates metabolic and extra-metabolic power use. Initially, new-borns, infants and babies have little interest in activities that involve extra-metabolic energy use. However, they can quickly become accustomed to activities like moving in an automobile or watching a screen, which require high levels of extra-metabolic power. In high extra-metabolic use cultures, babies are frequently accustomed to these activities by one year of age, or even earlier. Once individuals, of any age, become accustomed to extra-metabolically powered activities, they can find it difficult to return or reduce their power use back to strict metabolic levels, even for short periods of time. Nonetheless, recognition of the importance of pure metabolic activities like exercise, or in general of “slowing down,” is part of the cultural milieu among high power use classes and cultures.

Children, up to at least their adolescent years, even if they are highly entrained in extra-metabolic energy use through interaction with screens, use of domestic appliances, commuting in cars and long-distance travel, will always take deep pleasure in metabolic-level power use activities like outdoor play, hiking, walking, sports, creative arts, dance, theatre or almost any physical use of body movement.

Performance, as individual organisms, as parts of natural-cultural ecosystems, and as economic entities, will be enhanced by the faster cycling of larger amounts of energy. Most living systems over

most of their lifespan—and human individuals and economies are no exception—tend towards higher performance or towards lines of steeper slope in the power use space. The ability of humans to take conscious decisions and use technology to drastically increase energy availability and drastically decrease the time over which it is cycled, allows us to raise performance to levels beyond what any other living organism approaches.

Performance, success, “sustainability,” well-being and the wise use of power in raising a child

It is extremely important to realize that performance is not equivalent to success, well-being, or life fulfillment. Success, in an economic, evolutionary and ecological sense is best understood as current existence, and perhaps historical continuity from the past with potential for continuity into the future—the relation with traditional ideas about “sustainability” must be recognized here. Bacteria, arguably the lowest-performing life forms, have had historically unequalled success, since the first couple billion years of life history belongs to them alone, yet they continue to penetrate every environment of the present-day world and seem unlikely to suffer extinction even in the face of severe catastrophic events for other life forms. Thus, bacteria might well be the ultimate in “sustainable” life systems.

In the case of a complex human activity like child-raising, success can be even harder to define, but balance in the use of power would seem to be part of the equation. Undoubtedly, existence—that is the avoidance of mortality—is an important component. However, some high power use activities geared towards avoiding mortality, and thus enhancing evolutionary/ecological performance, might detract from the current sense of well-being and fulfillment that is part of the child-raising process itself. For instance, the purchase of an expensive full-safety-feature automobile might so indebt parents that they must work faster and more efficiently (high power use activities) with little time for slower, lower power use activities like conversation, cooking or outdoor play-time, or in fact any real time spent with their child. Worse yet, the unyielding and unfailing placement of a baby or child into a plastic safety car-seat (a high extra-metabolic power object) may deprive that child of needed warmth, human contact and consolation

(low metabolic-level power use) creating the potential for psychological neuroses and insecurity complexes.

We can now return to our question regarding “sustainability” or the wise use of power with a more specific framework for addressing it. Initially, we asked “How can we know who is in the right place, living the right way, at the right time, to lead a fulfilled life that minimizes suffering and maximizes well-being?” We now know that a given entity, let’s say a human family raising their children, can only be at one level of power use, or on one particular sloped line in the power use space, at any given moment. We also know that more spiritually-oriented activities—conversation, meditation, cooking and eating, walking and physical activity, communing with our surroundings and environment, prayer and many more— rarely involve extra-metabolic energy. Thus, the practice of these activities requires being, at that moment, on a very shallow slope line that would be considered low-performance. By recognizing where different activities are located in the power use space, we are able to now define our question in a mathematical way: What range of power use, as represented by the slope of the line in the power use space, is ideal for maximizing well-being and fulfillment during the start of a new human life? More particularly, what are the trade-offs that result from choosing higher or lower power use? Higher power use being understood as a steeper line with emphasis on economically-based, rapid-time-frame cycling of mostly extra-metabolic energy. Low power use being understood as a shallower line with emphasis on spiritually-based, slow cycling of mostly metabolic energy. As we’ll see in the Chapter Six, scaling or correlation analysis is the best tool for easily visualizing and analyzing these trade-offs.

However, before leaving the topic of spiritual versus economic power use, we must at least mention the question of “work.” In a strict physical sense, energy represents the potential to do work, which involves applying a force across a distance. As such, work always involves power, or the use of energy over time, as the force is applied. Although several layers of technology can remove us from the direct application of force over a distance, in essence the human, social or economic idea of work is ultimately based on the physics of work, power and energy.

Individuals and populations that use high levels of extra-metabolic energy almost always do their work with the help of machines and technology. Thus, it could be argued that their potential for deep enjoyment of metabolic-level activities, and in fact the luxury of choosing to do those activities, is a function of their daily power use level at work. For individuals and populations that routinely perform work in jobs that require manual labor and the use of their body's own metabolic power, a spiritual component to purely metabolic power use might be harder to justify or desire. However, although outside the topic of the current project, the spiritual content of one's work may also be dependent on how much metabolic energy is used. Typically, members of the high extra-metabolic energy work class strive to relax with hobbies or projects, often at home or at a volunteer location, where they "use their hands" to build, garden, cook, create or do something at the metabolic level. At the same time, members of the "metabolic-level working class" less often separate their work functions from the rest of their life (admitting a spiritual component to the work). In their leisure time, they may seek metabolic-level recreational activities, such as sports and dance. However, they might also be more inclined to include high-energy extra-metabolic activities in their leisure activities, such as mechanized sports.

Are lower, metabolic-level power uses always better, and are they always more spiritual?

Before examining the special role of scale in analyzing the use of power in the economic/ecological systems that we use to raise children, I want to clarify that I don't believe lower, or the lowest, levels of power use are always the best, always the most spiritual, or always lead to higher levels of individual fulfillment. In fact, the goal of this chapter is to build on our union of economic and ecological ways of understanding, along with our model for parsing power use into a mathematical energy/time space, and create a framework for analyzing the role of scale in the search for wise levels of power use in child-raising. As I've hinted at before, my preference is away from the extremes. And an initial intuitive preview suggests this is likely to hold for child-raising.

Let's take a look at the low-end power use extreme. I believe I am fortunate in having no first-hand experience with a fully metabolic-level power use existence. The anthropological literature

sometimes portrays the hunter-gatherer, “uncontacted” peoples as having ideal lives with low stress and high levels of “leisure” time (Liedloff, 1977). Although hunter-gatherers may have formed “the original affluent society” (Sahlins, 2005), this way of life also carries the cost of high infant mortality, short lifespans and the potential for periods of famine, direct violence, and disruption. Agricultural peoples who work the land with little or no extra-metabolic input may have even higher levels of infant mortality and shorter lifespans, along with heavier workloads, frequent famine, and little time for any other activity other than work devoted to mere existence (Waters, 2007). This extreme, then, of purely metabolic levels of power use, seems, at least intuitively, to present less-than-ideal conditions for raising a child.

At the other extreme on the scale of power use, we encounter the super-wealthy, in economic terms. Here, anthropological studies are few, but the daily media presents us with a “typical” view of this lifestyle, where children are often marginalized, receive minimal parental input, and families are frequently disrupted or dis-functional. Again, this extreme seems unlikely to provide maximal individual fulfillment, at least in the realm of child-care.

CHAPTER FIVE: So, what is the goal? The population level—success, performance, welfare and well-being.

Success equals survival and does not depend on performance

As I have mentioned several times already, living systems cycle energy. This can be analyzed at any level in the biological/ecological/economic hierarchy from cells (even the molecules within cells), individual organisms, families, populations, communities, biomes, cities, nations and so on. So far, the individual has been the focus of my analysis of energy cycling and the union of ecology and economics. I have shown that, for individuals, the extremes of power use, or energy cycling, are probably detrimental to overall well-being. At the high end, an explosive lifestyle can leave little time for the enjoyment of family and spiritual, metabolic-level undertakings. And at the low end of power use, we are likely to encounter extreme poverty with short lifespans, childhood mortality, famine and other factors that severely limiting well-being. Thus, ideally all the individuals in a population would be somewhere in the middle range of power use. But how do we decide what that ideal middle range should be? And how do we usefully analyze population data to determine what kinds of changes would take us closer to that ideal middle range of power use for the population as a whole, if not for every individual within the population?

From a strictly biological evolutionary viewpoint, all that really matters is success, which is defined as the ability to survive:

It is difficult to overstate the importance of continuity in the face of change as a manifestation of success....If an entity fails to adapt to new conditions, it can persist only if the old conditions—the environment to which the entity was adapted—continue to exist somewhere in the economy. Without such refuges, the entity will face extinction or, in terms more familiar to the human-centered economist, unemployment or bankruptcy.

Vermeij (2004), pp. 12-13

However, continuity, survival, or just avoiding extinction are very baseline metrics for determining ideal quality of life, or overall well-being. And at the same time, the myriad of factors, on

many different time and spatial scales, that enter into determining survival, make for difficult analysis. In Chapter Two, I discussed the panarchic cycles of boom, catastrophe, reinvention, and regeneration, as laid out by Hollings (2001, 2004). Major, catastrophic events, especially those that originate from well outside the variables of our every-day systems (an asteroid strike is a classic example) are very hard to account for, and the individual or population characteristics that will allow for survival from such random, rare and complicated events, are extremely hard to determine. Even more predictable events, such as economic downturns, or changes in diet patterns, lead to a cascade of secondary factors that can make predictability about who survives and who doesn't very difficult. It is very tempting to assume that better performance, which is relatively easy to measure for individuals and populations, brings about better success or survivability. However, no matter how performance is measured—more about this below—it is not the same thing as success. And in fact, very low-performing individuals and populations may well be “pre-adapted” to surviving or succeeding biologically in the face of the most severe events, where resources might be scarce and the ability to do *without* is the key to success. Nonetheless, day-to-day well-being for individuals may be, at least in part, dependent on performance. And a well-conceived and well-balanced population metric for performance might be one way of analyzing the factors that lead to higher individual well-being. Ofek (2001) argues that the ability for exchange and trade were driving selective forces in human evolution, showing a historical unity between the ecological and ecological idea of selection for performance. Before bringing performance factors into the analysis, however, I will examine more fundamental features of living systems that must be involved in population level analyses of energy cycling or power use.

The goal of reproduction is another fundamental characteristic of living systems, and of course an inherent component of success or survivability. Ironically, the goal of reproduction is inherently opposed to the goal of self-regulation, which is also a fundamental feature of living systems, and crucial to survivability/success. This is yet another way of framing the premise for the seminal sustainability work *Limits to Growth* (Meadows et al., 2004). Limitless biological reproduction, even starting from a microscopic bacterial cell, will lead inexorably, through exponential increases in biomass and energy

cycling, to an overburdening of any ecosystem, and even the entire Earth—not a well-regulated situation. At the same time, staunch and stable self-regulation calls for such slow energy cycling that sufficient resources to reproduce may not be garnered. (For several decades, the Ehrlich (1968) school of human ecology has decried, based on population growth curves showing us on an exponential upswing throughout the last century, that we are, in fact, already well down that road to complete resource overburdening.)

r/K selection theory regarding reproductive strategies, as outlined in the previous chapter, recognizes that there is no ideal level of energy cycling with an ideal level of offspring production. Larger organisms tend to favor self-regulation at the expense of producing large numbers of offspring, but favoring individual success and survivability. Small organisms, on the other hand, use relatively little energy, but are able to produce great numbers of offspring, most of whom die due to a lack of self-regulation that leaves them very exposed to the vagaries of predation and other environmental factors. In other words, on the scale of single generations, small, low-energy use organisms regularly face catastrophic events where large percentages of their offspring do not survive. However, for the population as a whole, this system is equally viable—that is it leads to equal success based on the continued existence of the species—with larger species which invest so much energy in individual self-regulation and maintenance that very few offspring are produced. This same trend is seen not only among species, but also within species, and especially within the human species where huge variability in energy use among populations can be found (see next chapter for an in-depth review of this phenomenon). It is easy to take a cold-hearted approach to morbidity rates among the offspring of non-human species and recognize that either r - or K -selection regimes might be equally successful. But for humans, can we be so cold-hearted, or at best blasé, knowing that the loss of a child must be a traumatic life-changing event for any family and for any parent. And given that knowledge, then, how do we arrive at the best level of energy cycling, leading to the best level of individual fulfillment, for a particular human population? Must we conclude that the best strategy is to garner all the energy possible to cycle into the total secure care of one single child? Or better yet, should we not have children at all and completely eliminate the

risk? Or, must we recognize that the population-level trade-off between reproduction and self-regulation is just one aspect of what leads to individual well-being, and that other factors—to give one example among many, the social-psychological adjustment of our children—might be equally important, no matter how many children we have? Perhaps the first step is to analyze, and try to come to know, define and measure, what the levels of population power use, or energy cycling really are.

What does Gross Domestic Product (GDP) tell us?

For human populations, Gross Domestic Product (GDP) is the most commonly used economic indicator. It is a complex metric, but at some level it represents the amount of energy that is being cycled through the population, and it is most commonly expressed as *per capita* GDP, thereby providing a mean average amount of energy cycling for each individual in that population. *Per capita* GDP can be increased, at the most fundamental level, in two distinct ways: 1) the amount of energy that is being cycled through the population, as expressed by economic activity, can be increased, or 2) the number of individuals in the population can be decreased. For an evolutionary biologist analyzing reproductive fitness using R/k selection theory, pursuit of higher *per capita* GDP must lead to extreme k-selection strategy. That is to say that since extreme k-selected species invest huge amounts of energy in small numbers of offspring, then the two ways of fundamentally increasing *per capita* GDP—more energy cycling and fewer individuals—are exactly what we expect in a k-selected species. (And as we'll see in the next chapter, this is the result we find in the most economically “developed” populations of the world.) If the goal of an economy/ecology is to reach higher *per capita* GDP, this goal represents, in its essence, an open acknowledgement that k-selection is the key to achieving whatever justification is given for increasing *per capita* GDP. Most commonly, that justification is in the form of a higher standard of living for everyone in the population. However, the crucial question that then surfaces is whether higher energy cycling among fewer individuals necessarily leads to higher levels of life satisfaction, or to better individual fulfillment, if this is in fact what is meant by higher “standard of living?” Once again, it might be best to consider the extremes. On the one hand, a relatively *r*-selected human population, where

resources are scarce and fertility rates, as well as infant mortality rates, are high might well achieve better individual fulfillment from increases in per capita GDP. However, at the same time, a relatively *K*-selected human population, where resources are overly plentiful and fertility rates, as well as infant mortality rates, are low might achieve better individual fulfillment from decreases in *per capita* GDP—a concept not often considered in either traditional mainstream or even many alternative economic perspectives (Michaelson et al., 2009)

Since the publication of Ehrlich's *Population Bomb*, it has become widely accepted that a decrease in population growth rates is crucial for avoiding ecological catastrophe, in its earliest cartoon version portrayed as an Earth where human populations reach a “standing room” only situation due to extreme over-crowding. Aside from some fascinatingly biased cultural, and logical, components to this argument (see the Box, “When will the bomb explode, Dr. Ehrlich” in Chapter Six), even the original proponents of the population bomb view now recognize that ecological catastrophe is equally tied to levels of resource use. However, what is not often analyzed is the biological fact, inherent in *r/K* reproductive fitness theory, that decreases in fertility rate are always correlated with increases in power use. And changes in one factor always lead to the correlate change in the other, almost no matter how the changes are brought about. Human populations are in no way exempt from this correlation. That is to say, increases in power use—be it through economic development, education programs, urbanization, or a host of other factors—always lead to decreases in fertility rates. At the same time, programs geared towards decreasing fertility rates—be they government-mandated as in China, or promulgated through social agencies or school programs—always result in concomitant increases in power use and *per capita* GDP. From a biological standpoint, a great case can be made for how natural selection and the priority of survival provide the causative factor in this powerful correlation.

Over the last decades, the population control agenda, along with major push for development of so-called “under-developed” economies, and perhaps just as a natural part of economic evolution, have brought increasing numbers of countries under the umbrella of relatively low birth rates and high power use or *per capita* GDP (Rosling, 2009, 2010). The insistence that ever-increasing *per capita* GDP is good

means that those countries furthest along this route, particularly the European and North American nations, have aging populations with high levels of energy use and very low birth rates, even sub-replacement birth rates (less than 2.0 children per couple). The concerns about a population explosion resulting in a resource crisis are gradually converting to a concern about the lack of young, working-age individuals who can support the heavy resource and societal needs of a large post-working-age, elderly population, or what is sometimes called a “high dependency ration.”

It is worth repeating that it is virtually impossible to predict whether this trend towards low-fertility, high-power-use populations results in better success in terms of survivability. The cycles of collapse and renovation are too complex to know which population might be at greater risk for collapse: high-growth, young, low-energy-use Rwanda, or low-growth, elderly, high-energy-use Italy, for example. If sustainability is about avoiding collapse, then we have little to say about which population is more sustainable. If, however, sustainability is about increasing individual life fulfillment, then we might be able to say something about what kinds of changes will take us in that direction.

The acceptance and use of *per capita* GDP as an indicator of positive economic situations is probably biologically based. It makes sense, that as biological organisms, we should want to increase our resource cycling. If this comes at the expense of a population drop in fertility rates, this is not immediately obvious to the individual who is simply trying to garner resources, and find a mate with whom to have offspring. However, what is clear is that survivability does not depend on increasing *per capita* GDP which is best viewed as an indicator of performance, but not success. In this regard, *per capita* GDP is probably a good indicator of performance, at least at the population and economic level.

Per capita GDP, as a measure of performance, can be a very useful statistic. However, two crucial things about it must be taken into account. First of all, as a mean average per capita, it fails to take into account disparity in the level of power use. High-end power users proportionally want, and usually get, higher increases in their share of the overall GDP. This means that the range and the standard deviation of actual power use is not represented and can be skewed terribly among the population. Data suggest that skewing of individual contribution to GDP has increased over time towards fewer, relatively

high-end power users and many, relatively lower-end power users (Kennickell, A.B., 2006; Thoma, M., 2006). The Gini coefficient (Gini, 1912) is often used to show the distribution of wealth within a particular GDP calculation, but very infrequently presented as part of the ultimate data result. Secondly, human self-awareness or consciousness may result in exaggeration towards reliance and acceptance of increased *per capita* GDP based on the biological instinct to cycle more resources. Whereas other species may, instinctually, arrive at a level of resource cycling which allows for sufficient short-term population performance and individual well-being while also improving long-term success and survivability, humans might be different.

Perhaps self-consciousness, along with society-wide communication through media that build on biological instincts, have led us to an unhealthy, counter-productive belief in the primacy of increasing *per capita* GDP. Of course, this would not be the only case of human self-destructiveness and addictive behavior. Human individuals, and sometimes populations as a whole, are capable of over-using drugs and alcohol, gambling to the point of collapse, and eating so much (or for that matter, so little) that our own organism becomes unhealthy. Could it be that the striving for ever-higher levels of *per capita* GDP is just a societal level manifestation of our big brain's self-conscious desire to increase resources. A good case can be made that all of these self-destructive behaviors take their basis from a healthy biological balance that then, perhaps because of self-conscious over-ride, become extreme in their manifestation, even if this is contrary to biological self-preservation, and even if this is contrary to societal, cultural and spiritual well-being. In fact, the entire societal, cultural and spiritual milieu may be contaminated by a self-destructive belief in *per capita* GDP, and the fast-paced levels of consumption and mobility that it represents.

Beyond GDP—welfare and well-being

If GDP is suspect as a good measure of life fulfillment, then it becomes crucial to ask the question whether the empirical correlation between increased power use and lowered fertility rates can be broken, even if it is reasonably explained as a strategy to enhance success and survivability. Exceptions

to the correlation do exist across cultures, time and geography. This is most often seen in the economically wealthy and powerful ruling classes. Here, high power use can lead, not to lower fertility rates, but to higher, and sometimes extremely high, rates of reproduction. The royal harem, in its many guises, is the epitome of this phenomenon among humans. But it is also seen among the “kings of industry” and other classes of economic leaders where large families have been, and are, considered a special privilege. In today’s geo-political setting, some petroleum-rich Middle Eastern countries have entire societies where high power use is coupled with high fertility rates (Moses and Brown, 2003). Although these high-end, ruling-class cases appear to break the rule, they still represent evolutionary success, at least for that part of the population that is able to maintain high power use and high fertility rates. In fact, this would seem to be the ideal for any population. However, these high power, high fertility rate individuals are attended by a servant population that often has low fertility rates, and in some instances has been forcibly sterilized. This situation is mirrored among the social insects whose society is organized around a high-energy-use, highly fertile queen who is attended by innumerable sterile workers.

The correlation can be broken, at least in limited fashion, where high power use and high fertility rates are combined among ruling classes. What about the opposite case—can low power use be combined with low fertility rates? And what are the implications of this scenario? Widespread cases of its existence do not immediately come to mind, although many practitioners of sustainability and survivalist lifestyles tend in this direction. As with the “royal harem” breaking of the correlation, these cases are probably outside the mainstream and seem unlikely to become the norm. Are we biologically inclined, then, to accept *per capita* GDP, based on the desire to hoard resources, as a good indicator of overall individual and population health and well-being?

It may be useful to discriminate between population economic goals and individual lifestyle goals. For economists, the ultimate goal of power use or energy cycling is what they call “welfare.” The system of production and consumption would have no meaning if some level of human existence, and all of the accompanying standard life-sustaining services, are not brought into being, summed up by the term welfare. This would include feeding, housing, education, health care, entertainment, and all the other

typical components of a home or household. At the individual level, the way in which these components are structured leads to a sense of life satisfaction or “well-being.” Economists assume that population welfare, as an outcome of the production/consumption system, leads to enhanced individual well-being. This is true for both traditional economists, as well as so-called “ecological economists” led by Herman Daly, who are mostly concerned with how close the economic system is to filling or maximizing what they see as a surrounding eco-system, or world environment.

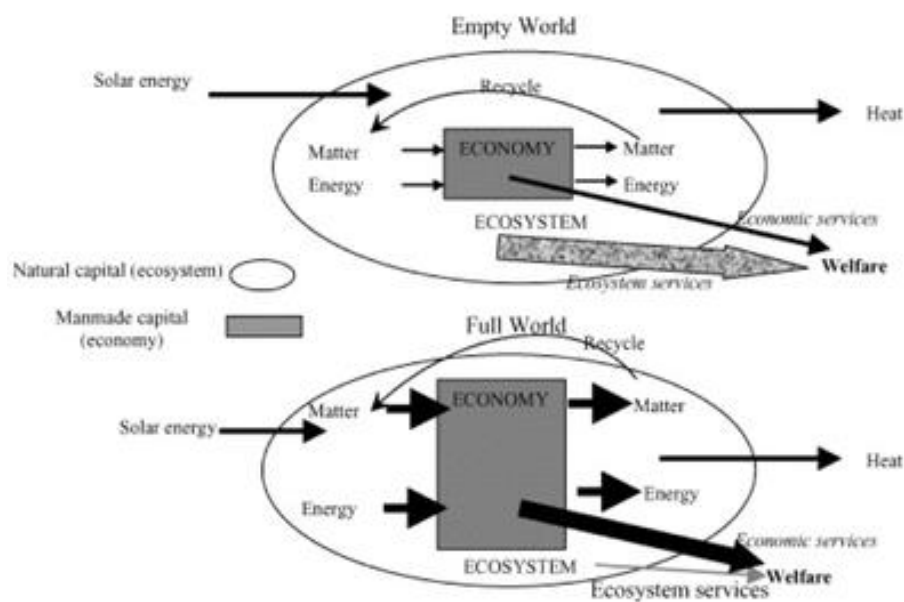


Figure Six. Matter and energy cycle through the economy in this view from Farley and Daly (2004). The result that represents human quality of life is the “welfare” output of the system. Traditional economists believe that more cycling leads to higher welfare outputs. Ecological economists, like Daly and Farley, believe that the contribution to welfare might actually decrease as the economic system encroaches upon the world eco-system, as in the bottom figure.

GDP, however, is not measuring population welfare or individual well-being, but rather performance in terms of energy cycling:

To economists, performance is usually expressed as profit. In the currency of money, profit can be employed to enrich the producer, to reinvest in the producing firm, to fund new ventures either by the firm itself or by its investors or to be redistributed as tax by the state for the real or perceived public purpose. [this is basically GDP] To ecologists, performance is measured as net productivity, the power beyond that needed for subsistence. The excess becomes available for growth, reproduction, or consumption [this is welfare]. Evolutionary biologists are accustomed to fitness as a

measure of performance. Fitness in this technical sense means the surplus of power devoted to offspring. This reproductive power can be allocated to large numbers of poorly provisioned young or to a few offspring that receive extensive parental care or investment. All three terms—profit, net productivity, and fitness—are special cases of power. The details of measurement vary according to discipline and context, but energy and time are integral to all measures of performance.”

Vermeij (2004), pp. 22-23

Vermeij makes a strong case that the economist’s profit, the ecologist’s net productivity and the evolutionary biologist’s reproductive fitness are all measures of performance. What is interesting is that only the evolutionary biologists, perhaps with the wisdom that their deep time, billion-year, Earth-history framework provides, recognize that the allocation of the performance parameter can vary greatly in its disparity. However, the same kind of *r*- and *K*- strategies that we see in reproductive fitness apply equally to profits in an economy, or net productivity in an ecosystem. As we already analyzed, GDP does not take into account the disparity in how each individual’s contribution might be skewed. Is it better to have a *K*-strategy with very few huge firms or individuals earning lots of profit, or an *r*-strategy with numerous smaller firms and individuals earning, each earning smaller profits. The extremes are probably not good. Inefficiency and a lack of incentive would accompany a perfectly equitable distribution of profits among all individuals in the society. However, concentration of profits among a small number of firms or individuals might lead to such relative deprivation among the now extremely numerous low-profit individuals that they may revolt and societal breakdown or collapse can result. The same analysis can be done for net productivity where concentration of resources in a few individuals of the species might lead to the inability to reproduce, especially if those individuals are dispersed across the range. At the same time, perfectly equitable distribution of small amounts of net productivity might lead to a situation where no individual can garner enough power to reproduce at all. This is the situation at the population level where it is difficult to argue that one particular model—for example, the equity model—for the distribution of performance results (*per capita* GDP) is the ideal case. But perhaps even more important is what this all means for the individual.

On the one hand, profit, net productivity, and reproductive fitness may all be special cases of performance. On the other hand, the kind of performance result that they provide to the individual is very different. Reproductive fitness results in the ability to have offspring and pass on one's genes. Profits result in the ability to have money, which can be used, as net productivity, to obtain additional material resources. Do we want stuff, or do we want kids—that is the question.

What levels of performance, and what kinds of power use, lead to individual fulfillment? The correlation between increased energy use and decreased fertility rates shows that *per capita* GDP, as a measure of performance favors the economist's idea of profit which can be turned into the ecologist's net productivity, which results in increased material wealth. However, the evolutionary biologist's reproductive fitness measure favors increased power investment in offspring, although not necessarily more offspring, depending on where we are in the *r/K*-selection regime.

What becomes increasingly clear is that GDP may well be lacking as a way to translate population performance into individual well-being. For those well-informed individuals who, one way or another, come to see beyond GDP, the “alternative lifestyle” mechanisms such as the Slow Food Movement (Heron & Waters, 2008), or Permaculture ethics (Mollison, 1997) are one way of expressing that dissatisfaction with the societal push towards higher *per capita* GDP. While these individuals may find a self-proclaimed sense of enhanced life fulfillment, society at large, and many of their peers may think they are eccentric at best, irresponsible at second-best, and simply not pulling their own weight in the greater scheme of societal good, at worst. Current trends suggest that the number of individuals willing to bear this burden of judgment is few, but perhaps increasing.

Another approach to battling the inadequacy of *per capita* GDP, and its inherent expectation that every member of society strive for higher levels of power use, is to change the analysis, that is to change the playing field and the rules of the game. Here, the potential to reach and change the vast middle class, through a policy-level, and society-level re-analysis of what it means to perform well, what ultimate success might depend on, and what the individuals' role in all of this, is fascinating. The proponents of alternatives to GDP are gaining traction, and it is now not uncommon to find GDP analyses accompanied

by disclaimers that recognize the limits of this metric. In addition, several alternative metrics have been established and calculated for various countries of the world.

National- or Population-level Accounts of Individual Well-Being.

Most economists recognize that GDP is limited in terms of what it measures. Specifically, non-market goods, such as ecosystem services, unpaid labor and leisure are not included (Wesselink et al., 2007). Depending on how these parameters are defined, and what is included, they are potentially greater contributors to economic activity and power use cycling, than the market-based goods that are included in GDP. Additionally, GDP focuses on the current economic flow, or the most recent levels of power use. That is, the cycling of energy during the ultimate measurement period (usually weekly or monthly measurements which are scaled up to a single year). Capital reserves, be they natural capital in the form of soil, mineral, water and air resources, human capital in the potential for human work, and even economic capital in the form of savings and infrastructure, are not reflected in the GDP calculation.

Numerous different metrics and indices have been developed to account for these shortcomings in GDP (See Figure Seven for a partial list). It is beyond the scope of this thesis to analyze the benefits and downfalls of the myriad approaches to expanding or enhancing GDP metrics so that they reflect these environmental and economic details. What interests us here is how GDP fails to account for the real quality of life, or well-being, that people experience on a daily level.

Name of Indicator	Developer of Index	How differs from GDP	Website
Indicator of Sustainable Economic Welfare (ISEW)	Friends of the Earth	Includes factor that accounts for economic inequalities in a number of natural and human environmental indicators	http://www.foe.co.uk/progress/java/ServletISEW
Wealth Estimates	The World Bank	Includes Produced, Natural and Intangible Capital	http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTDATA/0,,contentMDK:21062106~menuPK:2935516~pagePK:64168445~piPK:64168309~theSitePK:2875751~isCURL:Y,00.html
Adjusted Net Savings	The World Bank	Includes true savings rate after investments in human capital and depletion of natural resources and pollution.	http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTDATA/0,,contentMDK:21061847~menuPK:2935516~pagePK:64168445~piPK:64168309~theSitePK:2875751~isCURL:Y,00.html
Human Development Index (HDI) and related indices	United Nations Development Programme	Measures human achievement based on long and healthy life, access to knowledge and decent standard of living.	http://hdr.undp.org/en/statistics/indices/
Environmental Performance Index (EPI)	Yale University	Tracks policy categories related environmental, public health and ecosystem vitality	http://epi.yale.edu/
Environmental Sustainability Index (ESI)	Yale University	Composite tracking socioeconomic, environmental and institutional indicators	http://www.yale.edu/esi/
Sustainable Society Index (SSI)	Sustainable Society Foundation (SSF)	Includes 24 categories related to Human Wellbeing, Environmental Wellbeing and Economic Wellbeing.	http://www.ssfindex.com/
Canadian Index of Wellbeing (CIW)	Canadian Index of Wellbeing Network	Not a single index, but includes information in many categories of well-being: Living standard, healthy populations, community vitality, democratic engagement, time use, leisure and culture, education	http://www.ciw.ca/en/Home.aspx
Ecological Footprint	Global Footprint Network	Measures how fast resources are consumed and waste is generated compared to how fast new resources can be generated and waste absorbed.	http://www.footprintnetwork.org/en/index.php/GFN/
Gross National Happiness	The Centre for Bhutan Studies	Incorporates psychological well-being, time use, community vitality, culture, health, education, environmental diversity, living standard and governance.	http://www.grossnationalhappiness.com/gnhIndex/introductionGNH.aspx
Happy Planet Index (HPI)	new economics foundation	(see text)	http://www.happyplanetindex.org/

Figure Seven. A partial list of alternatives to GDP for measuring economic/ecological activity and its consequences for human well-being. A full analysis of all these metrics, their utility, and the extent to which they have been applied is beyond the scope of the current thesis. A few of the more pertinent and enlightening examples are discussed in the text.

For nearly three decades, Chilean economist Manfred Max-Neef has led the call for re-analyzing our understanding of what wealth means, calling for the primacy of “fundamental human needs.” Max-Neef and his colleagues (1986) have developed a so-called “taxonomy” of these needs, and the different aspects of how they are met (Figure Eight). As an economist working in the economically impoverished nations of South America, Max-Neef called for international “development” to approach the issue of improving national wealth through “human scale” development and a consideration of whether these needs are being met, before GDP, or some other simple metric of national wealth is considered.

Need	Being (qualities)	Having (things)	Doing (actions)	Interacting (settings)
Subsistence	physical and mental health	food, shelter, work	feed, clothe, rest, work	living environment, social setting
Protection	care, adaptability, autonomy	social security, health systems, work	co-operate, plan, take care of, help	social environment, dwelling
Affection	respect, sense of humour, generosity, sensuality	friendships, family, relationships with nature	share, take care of, make love, express emotions	privacy, intimate spaces of togetherness
Understanding	critical capacity, curiosity, intuition	literature, teachers, policies, educational	analyse, study, meditate, investigate,	schools, families, universities, communities,
Participation	receptiveness, dedication, sense of humour	responsibilities, duties, work, rights	cooperate, dissent, express opinions	associations, parties, churches, neighbourhoods
Leisure	imagination, tranquillity, spontaneity	games, parties, peace of mind	day-dream, remember, relax, have fun	landscapes, intimate spaces, places to be alone
Creation	imagination, boldness, inventiveness, curiosity	abilities, skills, work, techniques	invent, build, design, work, compose, interpret	spaces for expression, workshops, audiences
Identity	sense of belonging, self-esteem, consistency	language, religions, work, customs, values, norms	get to know oneself, grow, commit oneself	places one belongs to, everyday settings
Freedom	autonomy, passion, self-esteem, open-mindedness	equal rights	dissent, choose, run risks, develop awareness	anywhere

Figure Eight. Max-Neef and his colleagues taxonomy of fundamental human needs. Max-Neef believes that the extent to which these needs are being met, in all the different ways of meeting them, should be the true measure of the wealth of a nation, society or population.

Max-Neef's approach is deliberately non-statistical and avoids trying to make numerical comparisons among countries or populations. However, others, recognizing the importance of these fundamental human needs, have made attempts to incorporate them into a national-level account of human well-being that incorporates better information about quality of life than does *per capita* GDP.

The *new economics foundation* has focused sharply on human quality of life as a basis for developing national-level statistics with their Happy Planet Index (Abdallah et al., 2009), which has been calculated for most European countries, and has been distributed widely. The metric that they use is based on a series of personal and social well-being parameters, from which they developed a questionnaire that could be administered easily to a fairly large sample population. A close look at their well-being parameters show a heavy cultural bias towards Western ideals (see Figure Nine). And the results of their study show that Northern European populations fair best at being “happy.” Nonetheless, statistics on psychological health show high rates of depression and suicide in these populations. And the notion that “happiness” is the same thing as well-being runs counter to many other cultural bases, where the recognition that a full range of human emotions might need to be expressed openly, and that happiness and sadness are opposites in tension that form just one axis on the multi-faceted human experience.

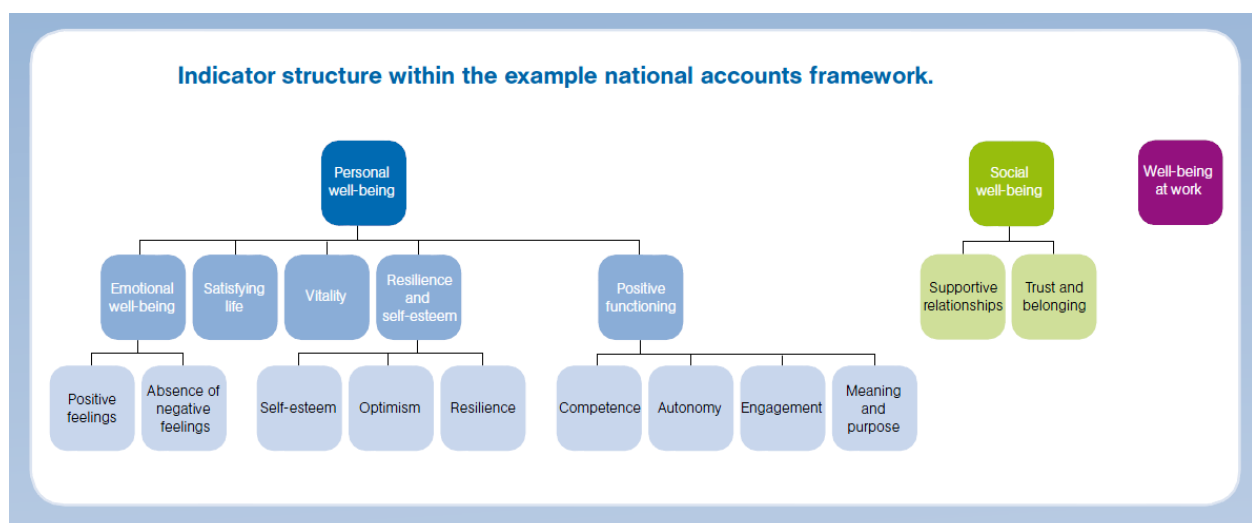


Figure Nine (from Michaelson et al., 2009). This figure shows the contributing elements to personal and social well-being that the new economics foundation used in developing their metric for calculating the Happy Planet Index.

Another view of sustainability?

As we enter into an analysis of the wise use of power in raising a child, it's important to keep in mind the relationship between population level analyses of performance, and what they mean for individual fulfillment. Sustainability, then, in my opinion, must incorporate a balance among several factors.

First of all, the trade-off between power use and fertility rates, further explored in the next chapter, must be kept at the forefront. If we focus on policy that reduces fertility rates, so often cited as the key to avoiding ecological catastrophe, it will inevitably lead to increases in power use, material consumption and ecosystem stress. If, on the other hand, we focus on reducing energy use, can this be done without an obligatory increase in fertility rates, or a loss in overall individual well-being?

Part of the answer to the trade-off between energy cycling and fertility rates may lie in our previous analysis of power use at the metabolic and extra-metabolic levels, and its significance for the spirituality that we encounter in our daily lives, and in the raising of our children. At an individual level, increasing numbers of non-main-stream middle-class families are taking the "slow" approach to eating, home-making and child-raising. However, for this to spread to the population at large, we need a re-analysis of *per capita* GDP that incorporates a more complete indication of overall human well-being. By including a non-economic component in our calculus for population performance, we might change individual behavior on a mass scale in such a way that people come to achieve higher levels of well-being as they move into lower levels of power use.

A pre-requisite to accepting a non-economic component to measures of population performance may be the appreciation that long-term success, and the avoidance of collapse, is very difficult to predict based on performance level. And in fact, the extreme, high-end power use individuals and populations might be as, or even more, vulnerable to collapse as the lower-end users.

If spiritual levels of power use, and a population metric that accounts for that type of power use, become the norm, then it might be easier to frame decisions that change trends regarding the number of children that families have, and ways of raising them that regularly take into account real considerations

about quality of life and individual well-being. Interestingly, that is exactly the kind of sentiment that most couples would claim for how they take decisions about forming a family. And also interestingly, it appears that public opinion is moving away from relying on GDP as a good indicator of quality of life (at least according to a small, but eloquent sample—Juggles, 2010). The task before us may well entail nothing more than convincing society to value what people and parents, in their hearts, already know: quality time, at a spiritual energy-use level is equally important as material wealth, especially once fundamental human needs are being met. If this is what sustainability means, then it may be easier than we ever thought. In the next chapter, I consider how to use correlation or scaling analysis to get at the heart of the real trade-offs around child-raising that might help convince society to (re)value spiritual levels of power use.

CHAPTER SIX: A framework for analyzing the role of scale in power use—energy cycling and fertility rates

Personal encounters with size and power use

The range of human variation in physical size can be startling. Finding myself and my family seated in a restaurant last week, and feeling towards the smaller end of the human size spectrum as we struggled to finish the “super-size” portions that had been served, we marveled as a similar family (in number and ages), but at the opposite end of the size spectrum, left the restaurant: Would they would have fit in our car? Were the huge restaurant portions intended for them? And what are the trade-offs in quality of life among adult humans whose body weight can vary two to three-fold? What might happen in a survival confrontation among adults who stare eye-to-belly-button? Who is, and will be, more sustainable? Who lives a more fulfilled life? Who uses power more wisely?

I have become increasingly convinced that scale may provide a crucial perspective for analyzing the implications of power use for us, as individuals, on a daily basis, as well as for human populations over longer periods of time. The goal of this chapter is establish a framework for using scaling analysis as one way of understanding the trade-offs that present themselves as we move from one level of power use (one particular sloped line in the power use space) to another. More specifically, the goal is to see if we can create a model for finding the particular level of power use that brings maximum individual well-being across the population in a given aspect of child-raising. I use an example from the ecological literature, looking at the relationship between fertility rates and energy use, as the most compelling approach I have seen to power use in human populations.

On Being the Right Size

Comparative biologists have long recognized that size may be the single most important constraining feature of organisms relative to the environment in which they live. In his classic essay “On

Being the Right Size,” J.B.S. Haldane (1985 reprint of 1927 essay), one of the formative Darwinian synthesis geneticists, analyzes how fundamental physiological processes and absolute physical features of the environment can greatly influence the form and function of a biological organism. Haldane points out that, due to nothing more than size difference, gravity, which is a significantly dangerous force in our own environment, is barely felt by a fly who, on the other hand, can drown under the surface tension of water, which we barely feel as a significant force. Since Haldane’s time, comparative physiologists and biomechanicians have established a rich field of investigation using quantitative scaling correlations based on size differences among individuals and species (Schmidt-Nielsen, 1984). Generally, these biologists look for how size constrains or governs certain aspects of organismal variability due to physiological needs of the organism or due to ecological factors in the environment. Many previously mysterious organismal features have been explained satisfactorily on the basis of size-related constraints. Ecologists have also been fascinated with size, and especially how it can explain partitioning and the occupation of certain niches in an ecosystem (Allen & Hollings, 2002). However, ecologists have rarely used size and scaling analysis to understand the limits or trade-offs in ecological systems (Allen and Hoekstra, 1992).

Scale Theory in Evolution and Economics: an example of the importance of scale— human energy use and fertility rates

James Brown, a theoretical ecologist at the University of New Mexico, has devoted his academic career to analyzing and compiling large amounts of ecological data, and explaining those data based on size-related physiological constraints of the organisms involved. A fascinating analysis by Brown, together with one of his colleagues, Melanie Moses, a computer scientist with interest in biological networks (Moses and Brown, 2003) is worth reviewing in detail as a superb example of how size/scaling analysis might help us understand the trade-offs involved in pursuing particular solutions to the question of how we might best use power in the raising of a child. By extension, the model that Brown and Moses present has implications for how we respond to the “limits to growth” or what affects the sustainability of

a human ecological/economic system. In this article, Moses and Brown quantitatively analyze huge geographic and historical differences in human energy consumption along with changes in fertility rates using exponential scaling relationships based on body size.

For all mammals, energy use, or metabolic rate (B) is positively correlated with their size or body mass (M) under the well-developed, empirically-supported exponential (or scaling) equation:

$$B = B_0 \times M^{1/4}$$

where B_0 is a scaling constant.

This equation predicts the observed typical metabolic rate for a 60 kg human of approximately 2500 calories per day, or 130 watts, a little bit more power use than a typical incandescent light bulb.

For most organisms, total energy use is accounted for by the metabolic energy needed to fuel the body's cells, and so for a typical 60 kg human, a 2500 calorie daily diet should serve to fuel all the body's cells, and thereby keep its total physiology functioning. In the case of humans, however, as we've already seen, technology takes us far beyond simple metabolic energy needs and energy consumption includes not just food intake, but the consumption of oil, gas, electricity and other energy resources, or what Moses and Brown call "extra-metabolic" energy. This "extra-metabolic" energy consumption ranges from a few hundred watts per capita in the poorest countries to many thousands of watts in developed countries. In the United States, per capita energy consumption in year 200 was 11,000 watts, which is about 100 times the basic metabolic or food-intake consumption. Moses and Brown point out that if this level of energy consumption is plugged into the energy scaling relationship, the result is that the average modern U.S. citizen consumes energy as if it were a 30,000 kg primate.

According to Moses and Brown, other biological rates, such as cellular processes or reproductive rate scale as body mass to the $-1/4$ power and so, doing the math, it results that most biological rates (R) should scale with metabolic rate to the $-1/3$ power or:

R is proportional to $B^{-1/3}$

Since fertility rates are also well-known for many mammals, the relationship between fertility rate and metabolic rate can be plotted and the resultant scaling exponent closely matches the prediction from this second equation—Moses and Brown present summary data for mammals and primates to show scaling of fertility rates among mammals and a time series from the U.S. to show fertility rates as power use in human populations increases (Figure 10.)

They then go on to compare the great range of human “extra-metabolic” energy consumption with fertility rates. Their data come from over 100 nations and span the time period from 1970 to 1997. They find that the very same predicted and observed $-1/3$ scaling exponent applies when comparing human energy consumption with fertility. In other words, just as for all mammals, overall metabolic rate (now including “extra-metabolic energy use) and the resultant “virtual” body size, can explain the nearly 10-fold range of human fertility rates. Poor countries, where energy consumption is barely beyond typical food intake, have very high fertility rates. However, in developed countries, where energy consumption is extremely high, fertility rates drop, as individuals extend their reach into the energy network to a point of consuming as if they weighed 10,000’s of kilograms.

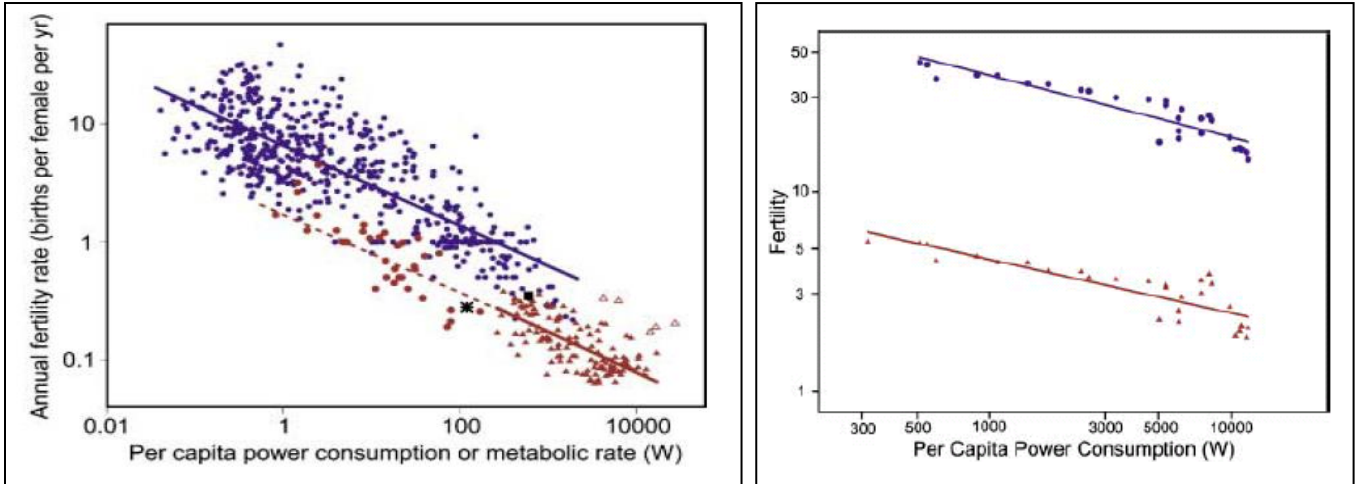


Figure 10 (from Brown & Moses, 2003). Fertility rate with power use in mammals and humans.

On the left is fertility rate of humans and other mammals plotted as a function of power consumption. Power consumption is estimated as metabolic rate for mammals and extra-metabolic energy consumption for humans. Circles represent mammals, with primates in red. Red triangles represent nations and empty triangles are outliers. The black star and box represent human hunter-gathers and pre-industrial agriculturalists, respectively. Fertility was measured as average number of births per female per year of reproductive life for species of mammals and nations of humans using data from 1990 to 1995. Metabolic power (B) of mammals was estimated from body mass using the allometric regression equations for different orders of mammals (Peters 1983). Hunter-gatherer and agriculturalist fertility rates and metabolic consumption are estimated population averages (Livi-Bacci 1997). The blue line shows the regression equation for annual fertility of nonprimate mammals, $6.54 \times B^{-0.339}$ ($r^2 = 0.68$, $P < 0.001$). The red line shows the regression for humans, $1.89 \times E^{-0.346}$ ($r^2 = 0.47$, $P < 0.001$). The dashed line is extended to show the fit through the primate data. The exponent values of -0.339 and -0.346 are well within the 95% confidence intervals for the predicted value of $-1/3$.

On the right is the decline in fertility rate as power consumption increases nearly two orders of magnitude from 1850 through 2000 in the U.S. The slope of the line fits nearly perfectly with the typical scaling relationship seen among mammals as they increase in size, and therefore power use and their fertility drops. Circles represent crude fertility rate (births per thousand population) and triangles represent lifetime births per woman. The slope for crude fertility is -0.31 ($r^2 = 0.83$) and for total fertility is -0.27 ($r^2 = 0.76$).

This scaling relationship within humans reflects the basic trend for larger mammals to invest far more in their own metabolic upkeep and to have a small number of high-needs offspring. In the human case, among some developed nations, fertility is actually below 2 (which would be needed for replacement of the population) and the energy-extended current human population is actually shrinking.

Most often, we assume that a particular human behavior, like reproduction, reflects conscious decisions on the parts of the individuals involved. Demographic analyses of human population growth speak of the “demographic transition,” from high fertility to low fertility, which inevitably accompanies

increased economic wealth (Caldwell et al., 2006). But the roots of this shift are almost always analyzed from a social, political or economic perspective, with the assumption that individual decisions about reproduction are what determine fertility rate. This is despite the fact that, for any other species, the usual assumption is that ecological factors determine fertility rates. The Moses and Brown article puts humans on the exact same scaling curves with any other species, subject to the same kind of cold, hard numerical analysis of population behavior that James Brown would apply to any other set of ecological data:

“In our analysis, parents have as many children as they can afford to provision with the energetic resources expected in their society. As the cost and time to obtain these resources increase in more industrialized nations, the number of children parents can support decreases.”

Moses and Brown’s study thereby flips the usual assumption about reproductive decisions. Most of the social and economic-based demographic studies assume that greater wealth brings about the luxury or ability to regulate fertility and to therefore “decide” to have fewer children. But based on this work, does it not make more sense that greater wealth so constrains the energy-extended 30,000 kg virtual individuals that they simply cannot reproduce at a higher rate? The implications for sustainability approaches are weighty, but our integration of economic and ecological perspectives can help us see the value in this kind of scaling approach. We need to think, not only about how poverty might keep Southern populations from acquiring sufficient resources, but also how wealth might constrain Northern populations from entering particular ecological niches, or from changing certain behaviors that affect their environmental relationships. Perhaps to achieve higher levels of individual fulfillment, and at the same time a wiser use of power (call it “sustainability” if you like), we need a program of conservation and development work, based on reverse South-North transfer of technology and cultural values, to be undertaken in North American suburbs. Rather than working towards reducing fertility rates among poor Southern human populations, it may be more “sustainable” to work towards bringing wealthy Northern populations’ energy consumption down to the point where families can provision many more children. (see Box: When Will The Bomb Explode, Dr. Ehrlich?). The actual environmental cost of those

additional children will be far less than the 30,000 kg individuals that a typical energy-extended North American family is currently raising.

Box 1: When will the bomb explode, Dr. Ehrlich?

Ever since publishing *The Population Bomb* (1968), Paul Ehrlich's ideas have dominated many approaches to sustainability, despite the fact that many of his predictions have proved wrong. Admittedly, they contain a compelling logic: human populations (or those of any species, for that matter), cannot continue to increase at exponential rates—eventually they will outstrip their resource base, or even their physical environment space.

Thus, this way of thinking has argued, let's see where human populations are increasing most rapidly? Answer, obviously: in the "Third World." Then, let's recognize that this is also where people are apparently suffering the most from famine, and work towards bringing their population growth under control so these poor, breeding-like-rabbits people have enough to eat.

Layer onto this primary argument the wonderfully humanist goal of providing social and economic "equity" and we have a convincingly compassionate set of solutions for achieving resource sustainability.

Except that I don't buy it.

Turn the logic around

In an update article, Daily and Ehrlich (1996) argue for social and economic equity—within and among households, among regions, and among nations—as a solution to lowering fertility rates. This is the focus of the article, although they also first also look at how the same factors might increase food production. The same old problem Ehrlich has been facing for years: need to provide more food for over-fertile poor people. Maybe, though, the problem is not in controlling fertility rates. Pure ecologists rarely think about fertility as a primary cause of anything, but rather focus on those environmental conditions that determine fertility rate. The food (and other resource) supplies that Daily and Ehrlich want to help increase may be exactly what determine fertility and population growth rates. Factors such as education, access to contraceptives, and whether women consciously choose to have each child, may be secondary (see Moses and Brown, 2003 for an ecological scaling analysis of the strong correlation between energy use and fertility rates). Daily and Ehrlich admit that data about these soft social factors are hard to interpret in terms of their relationship to fertility.

Where does their argument go wrong (and immoral)?

First of all, treating population growth as a problem rarely succeeds as a biological control policy. It might locally contain a pest problem—rat poison, pesticides, open hunting on rattlesnakes, deer, wolves, bears and other ways to bring down population of "wild" animals can make a local difference. And this can greatly improve human quality of life. But direct population control rarely works as a comprehensive program for increasing, decreasing or eliminating populations of animals. It almost always has secondary consequences that might be worse than the initial problem. China has quickly and dramatically brought population growth down. But they are facing serious environmental consequences in terms of resource use and pollution.

In the case of humans, if our goal is to achieve resource sustainability, and we want to apply a "control" approach to the human population "problem," the solution quickly becomes obvious. And it is not one that I think Daily and Ehrlich would like. Just the idea of selective culling of the human population is morally repugnant. But worse yet, where should we cull? Obviously where resource use is greatest. So, a typical biological pest approach to human overpopulation (relative to resource use) means heading out to the Northern suburbs, starting in the U.S. Where do Paul Ehrlich and his colleagues live? Palo Alto, California, which must rank high on the list of *per capita* resource use, might be a good place to start.

Secondly, Ehrlich, perhaps because of the cultural bias that informs his worldview, believes that humans worldwide take the same kind of careful decision about conceiving each and every child that he and his culture might. I have a hard time refuting the notion that each child should be a “wanted” child. But I doubt the way this value is understood and applied in Northern suburb culture will work throughout the world. And, in fact, its promotion starts to make Northerners look rather heartless. Is this coincidence?

I don’t think so. Because, thirdly and perhaps most ironically, Ehrlich’s relentless pursuit of population control strikes at what might be a universal human value: children as our most prized possession. Northern suburb culture has largely over-ridden this universal value, and this over-ride allows intellectuals like Daily and Ehrlich to form a worldview that starts with population (and its most obvious and bountiful gift—children) as a problem. It’s hard to disagree that people experiencing famine should have more to eat. But I would hate to be the one to tell them that the solution lies in not having children, or even in having fewer children. And I would have to think that the bearer of this message might well be suffering, psychologically and emotionally, as much or more than those who are in famine. Which leads us to what is most ironic about the Daily and Ehrlich approach: should not the barely fertile, high-resource consumers in the North consider their own level of satisfaction, welfare, and non-economic well-being first; and then decide how to regulate population and increase food resources in the South, and among the economically poor? Or perhaps decide it’s none of their business.

The “caveat” proves the point

Daily and Ehrlich do provide a “caveat,” although they don’t discuss how it might be achieved. The caveat is that the “equity” they promote must come about, not only through increases in economic wealth among poor, but concomitant decreases among the wealthy. Nonetheless, the scant data they provide on how fertility rates might relate to economic and educational levels are all from “Third World” countries. They never look at how these same factors affect fertility among wealthy countries.

The article should start with the caveat and then turn the entire argument on its head. It is not a question of the Northern wealthy *sacrificing* something about their lifestyle in order to meet the economic equity goal midway. It is about the Northern wealthy recognizing the *values* which economically poor Southern cultures might teach them. These values include the recognition of children as a sacred gift, not just another statistic that we can push around the chessboard. Then, changes in Northern behavior might lead to resource distribution that will allow for population growth to slow, not through forced behavioral changes imposed on Southern poor, but through Northern wealthy populations realizing that their non-economic welfare might be improved by changing *their own* behavior.

(Note that logically backward solutions to problems that seriously deplete human satisfaction are common when facing the real logic might be initially painful for the power class. Addictive drug use is a classic example where blame is placed on economically poor suppliers, often without facing the problem of demand from economically rich, but spiritually poor, consumers.)

The reason food supplies are limited where people are poor is probably because the wealthy North has, historically, controlled access and use of capital, both physical and human, in those regions. Searching for and promoting equity in the distribution and use of capital might bring down population growth, or it might not. But it should allow for an increase in human welfare *if* the Northern, wealthy, power culture recognizes that its own psycho-spiritual-emotional, non-economic welfare and satisfaction depends on it.

Save thyself first, Drs. Daily and Ehrlich.

In China, legislated reduction of fertility rates (the one child per couple law) has quickly brought population growth down, generally cited as one of the great goals of sustainable development. However, perfectly reflecting Moses and Brown's scaling relationships, this reduction in Chinese fertility has come with the expected scaled increase in energy use. In fact, some argue that acquired economic wealth, as much as the one-child law, has been the key factor in reducing China's fertility rate. So, the question for sustainability proponents is which approach is more compatible with reducing the chance for collapse: reducing population growth rates, or reducing energy consumption rates? It is probably impossible to have both. Choosing between these priorities results in almost diametrically opposed "sustainable development" initiatives: The "reducing population growth" goal justifies typical initiatives that force birth control and family planning on poor Southern populations, whereas the "reduce energy consumption" goal suggests that the correct course of action would be re-convincing wealthy Northern populations that it might be worth devoting more of their available "metabolic energy" to raising larger numbers of children. This in turn should result in a reduction in "extra-metabolic" energy consumption as the family—not work, entertainment, and shopping—become the focus of a fulfilling life. As for which tactic would lead to less world-wide energy consumption, the correct approach would be convincing Northern populations to have more children and use less energy.

Perhaps more important, however, is which tactic will more successfully reduce suffering: the question is posed by the hard numbers of a well-done ecological scaling analysis, but best answered by a softer science approach where we try to find common ground between the realities of suffering and fulfillment experienced by people at far ends of the energy use spectrum, or on very different slopes in the power use space. This is just one example of how scaling analysis can so dramatically frame a power use trade-off in terms that make no assumptions about whether a particular lifestyle or society is "more sustainable."

Scale theory in ecology

Moses and Brown present just one way of analyzing scaling relationships in ecology. Other methods exist, although surprisingly few ecologists have considered the role of scale, despite its apparent primacy in determining the flow of energy, the use of power, and the ultimate performance, of different elements in an ecosystem.

Allen and Hoekstra (1992) analyze how what they call “criteria” for environmental analysis could be understood from several different size or “scale” perspectives. They look at how landscapes, ecosystems, communities and biomes might be perceived very differently depending on the “scale” of the organisms that are under consideration. They also argue that a unified ecology should include multiple levels in the biological hierarchy from several different size perspectives. However, they almost completely neglect to apply the tools of mathematical exponential scaling relationships to their ideas. Instead, almost apologizing from the start (Allen & Hoekstra, 1992, p. 2), they use the idea of scale to simply indicate size and then compare “large-scale” and “small-scale” situations. However, they do lay out a strong precedent for considering the effects of size on the ecological factors that might be important to different levels in the biological hierarchy. O’Neill and King (1998) provide a good critique of how hierarchical approaches to understanding scale might not be valid

In one of the most sophisticated uses of scale for analyzing ecological systems, Allen and Holling (2002) see discontinuous breaks in the distribution of elements in the ecosystem (Figure 11). They look at spatial and temporal scaling factors in a boreal forest, in which they consider a non-human-intervened ecosystem. They also consider (Peterson et al., 1998) the role that scale plays in the resilience, or resistance to collapse, of ecosystems.

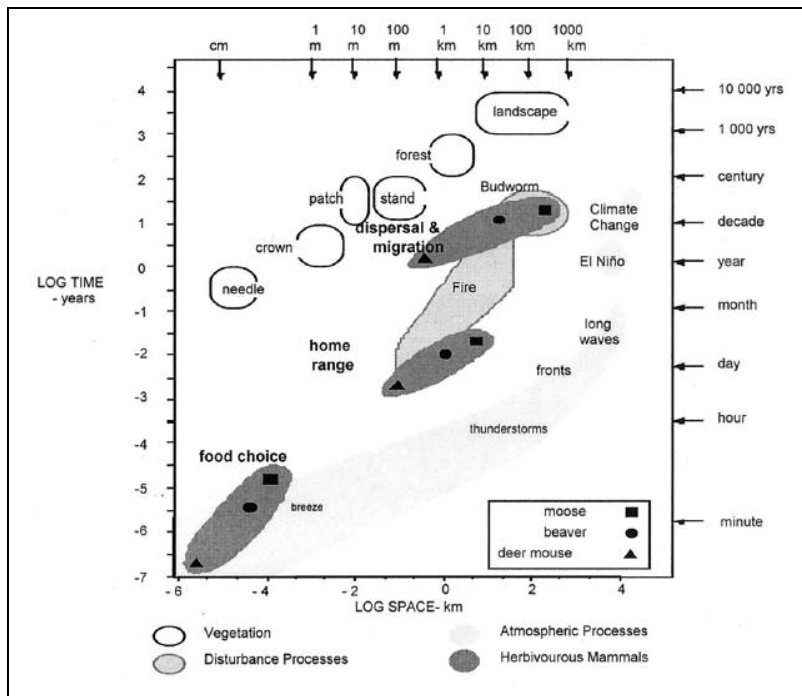


Figure 11 (from Allen & Holling, 2002). Scale breaks in ecosystems. Time and space scales of boreal forest showing relationship to some of the processes that structure the forest. Note the breaks in scale, or how the processes cluster around certain regions in the time-space plane.

In order to emphasize the all-important role of scale at all levels of the hierarchical organization of living systems, it is worth briefly reviewing some obvious implications of scale at different levels. My goal here is simply to suggest ideas that require further pursuit. Although I've organized these ideas around different levels in the biological hierarchy, I realize that most of the topics would require the kind of cross-hierarchical analysis that Allen and Hoekstra (1992) encourage.

Molecular/cellular level: At this level, size is very constraining and probably cannot be greatly altered greatly, at least not yet. The molecules that enter into living systems (fats, carbohydrates, proteins and nucleic acids) are uniform, constant and presumably unalterable in size, although it is interesting to see how physical gene space, and the number of cellular metabolic reactions catalyzed by proteins, will be solved in the future. By the same token, molecular processes, most notably diffusion, must place constraints on cell size. In turn, scale-related cellular properties constrain what multi-cellular organisms are capable of doing. However, it is hard to imagine useful scaling analysis at the cellular level that can

inform us about trade-offs in ecologically important processes related to the wise use power in child-raising, but this may only reflect lack of imagination. As the 21st Century of Biological Technology unfolds, imagination may well be filled in with new technological realities related to the application of genetic and cellular technology.

Organismal level: This is where scaling is most obviously seen and understood. How we, as individual organisms, form part of a population and interface with our environment, is perhaps the most common focus for human ecology studies, and especially for how they relate to ideas about sustainability. The following factors (using Golley, 1998, as a guide) may merit a numerical scaling analysis of how we humans, with our full range of “virtual”, or extra-metabolic-energy-use-based size, interact with features of our environment:

- Energy dynamics (done by Moses and Brown, 2003, for fertility)
- Landscape features including number of species in the landscape, soil composition of the landscape, and any other typical quantifiable ecological feature of the landscape
- Watershed features including water use, distribution of water and water disposal
- Waste disposal including metabolic waste, garbage and industrial waste
- Climate space including home costs, landscaped space, urban services.
- Land use including home, transportation, agriculture, etc.
- Food production and distribution and its many quantifiable aspects

Population level: Here the focus is on interactions among individuals within the same species. Certain population features require scaling of population size against the environmental factor of interest. Others could be analyzed by using the full range of “virtual individual size” within a given population as the basis for scaling analysis. Many population level factors are likely to have been analyzed previously, at least for industrialized and “first-world” populations. Scaling analyses that relate population size to life history adaptations such as fertility, age structure, family structure and social structure may prove

interesting in terms of understanding fulfillment trade-offs. Population demographics have been extensively studied, but rarely compared, in a quantitative way, to individual “virtual” size based on energy use. Moses and Brown (2003) do this for fertility, but what about other demographic statistics like death rate or population age structure? Finally, more complex social structures, like form and size of government or how health care and education are provisioned, might be interesting to try to quantify and then compare to either population or individual organism size.

Community and Ecosystem level: Here, the main consideration is relationships among organisms and populations of different species. Possible scaling studies would include analyzing how our “virtual” size affects our ecological relationship with domesticated species, as well as “wild” species. This could be approached using qualitative categories such as the nature of the inter-species relationship—predation, mutualism, symbiosis—or quantitatively in terms of the number of species or varieties with which we interact. Another approach would be to analyze how size (of the population or individuals) affects the composition of the biotic community in which we live. Again, this could be done qualitatively in which case the idea of *Umwelt* (Allen et al., 2003, p. 175) might be important, or quantitatively by looking at some numerical aspect of that biotic community, such as species diversity or average species range.

Biome or biosphere level: This is the level where human global populations will ultimately meet their limit to growth. Past collapses have always allowed for migration and movement into uninhabited region. It’s possible, however, that the current global spread of human populations and global use of resources, could lead to a form of collapse where migratory encounters with new habitats and resources are impossible. At the biosphere level, the most quantitative scientific approach to sustainability and “collapse” has been undertaken. Greenhouse gases and global warming have received a great deal of attention. The computer models that frame the problem of global warming take into account the size of human populations and their growth, as well as individual human energy use. Sometimes they consider the effects of size and scaling, both at the individual and population level.

Since we are left with nothing greater than the biosphere itself, this is perhaps where we need to consider the ultimate consequence of size. However, scaling analyses focused on lower levels in the biological hierarchy frame real-life trade-offs that suggest immediate and individual actions which could change our destiny, hopefully towards one that includes less suffering.

How can we use scale to understand where peak fulfillment regarding power use lies?

Brown and Moses analysis produces a summary graph which is void of any value judgment regarding where the wisest use of power might lie. If, as argued in Chapter Two, wise power use leads to maximizing fulfillment (for individuals in both a spiritual and physical sense) and this leads to populational well-being, then a certain point or range on the energy use curve should coincide with peak fulfillment (Figure 12).

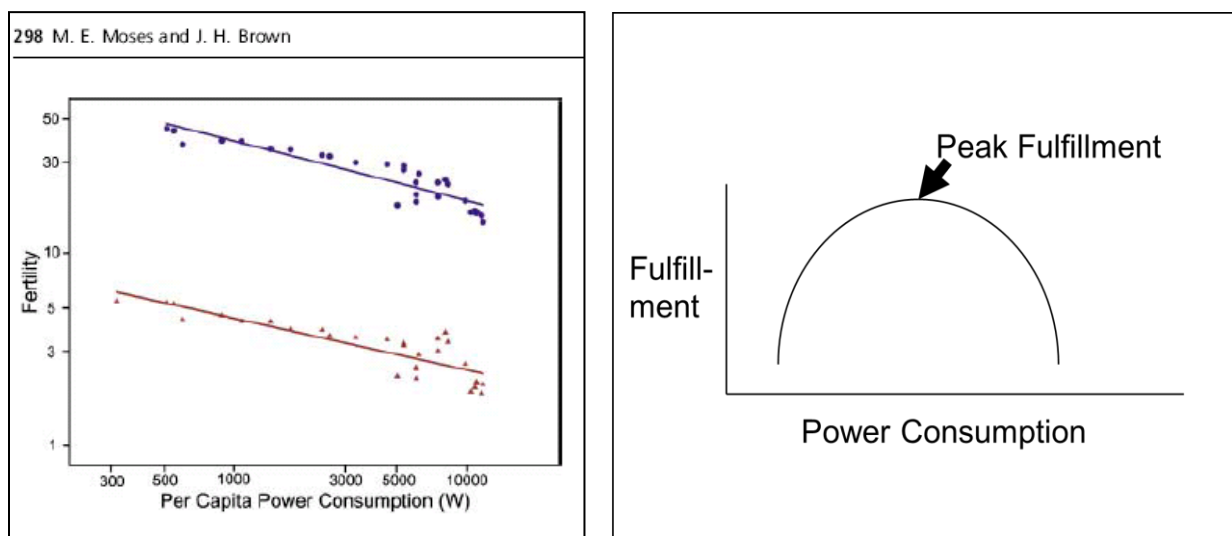


Figure 12. Scaling analysis for factors that affect non-economic well-being. Moses and Brown's (2003) scaling analysis shows how fertility decreases when non-metabolic energy use increases (on left). There must be a point on the power consumption curve where fulfillment, as regarding fertility rate, is maximized. Intuitively, this would not be at the extremes, but somewhere in the middle, although a rigorous analysis of fulfillment is called for to verify this intuition, and to narrow down the range of power consumption where peak fulfillment is found.

To further clarify the point, let's imagine another hypothetical example involving food and diet where scaling analysis might lead us to power use tradeoffs: the relationship between median family income and

calories in the diet. Again, this analysis would just point out one trade-off that accompanies increased economic level. Somewhere along the scaling curve must be a point where fulfillment or well-being, with regards to dietary calories, would be maximized (see Figure 13).

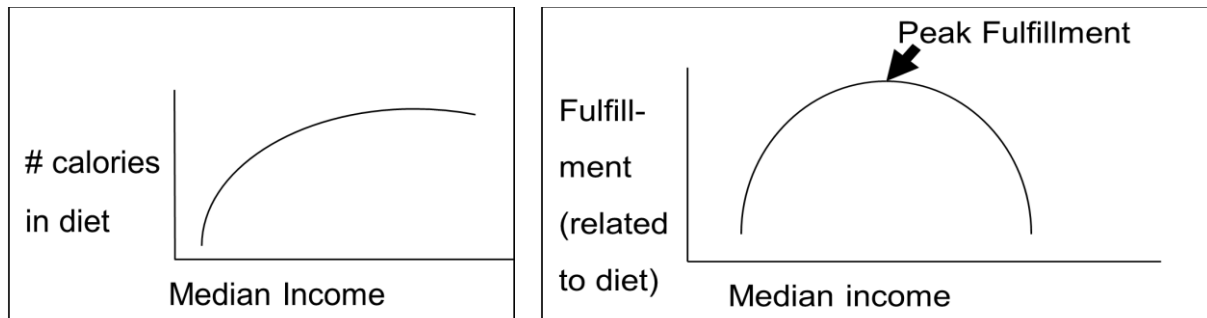


Figure 13. Hypothetical scaling relationship between median income and calories in the diet. On the left, a hypothetical scaling relationship showing that as median income increases, calories in the diet increases. On the right is a hypothetical interpretation showing that there must be some ideal income level where peak fulfillment is achieved.

Vermeij (2003) in his elegant integration of economic and ecological systems of analysis, also points to scaling effects as principal determinants of the structure and performance of a particular system, at any level in the hierarchical organization of life. As I mentioned in Chapter Three, he views five aspects of scale that are important for how ecological/economic entities perceive and respond to the environment, and ultimately for their performance:

- Physical size—length, area, volume or mass.
- Reach—distance, area or volume traversed by a mobile entity
- Number—number of units or a measure of population
- Duration—length of time of an event or lifespan
- Frequency—number of events or units per unit of time or lifespan

For child-raising, the most important levels to analyze in the hierarchy of living systems are probably organismal/individual, populational, eco-system, and perhaps biome/biosphere. For each of these levels of organization, different aspects of scale will play a dominant role. For example, for the individual

organism, physical size and reach might be more important, whereas for a population the number of units and their duration may play a greater role. However, all of these elements of scale will ultimately influence the performance, in terms of power use, for the entities—individuals, populations, ecosystems and biomes—that are part of the child-raising milieu. The task at hand is to analyze real data, mostly for individuals and populations, and see how the levels of power cycling, as understood in the energy/time power use space, lead to different kinds of fulfillment as understood, mathematically, by a sloped line in the power use space, and intuitively as spiritual realization versus physical/economic performance. Then we can look at where, on the scale of power use represented in our data, we might define different types (monetary, spiritual, resilient, etc.) of peak fulfillment.

As promised, we've created a concrete, mathematical/physical framework for dissecting tradeoffs between spiritual and economic uses of power in raising a child. The Seven Simple Truths (laid out in Chapter Three) guide us as we struggle with how to analyze power use in its potential for increased population well-being and individual life fulfillment; and as we look for what kinds of trade-offs this pursuit might bring? By forging this synthetic ecologic and economic perspective on the movement of systems towards high performance, we can see how humans “fit” with the complex environments in which we lead our lives. We can then use our data to bring us to a better mathematical understanding of the ways in which the scale of power use leads to higher performance, often defined in terms of higher energy use and quicker cycling of the energy. Our mathematical understanding of power use can then be interpreted in the context of peak fulfillment, in both physical and spiritual sense.

At the same time, it is crucial to keep in mind that our “cold, hard” data are a product of, and mired in, a historical context, which forms a crucial part of the union between ecologies and economies. We can analyze population performance mathematically, but success, in terms of viability, is a historical concept, and one whose achievement is inevitably contingent on what has come before, and what might be to come. Individual fulfillment, on the other hand, is often subjective and very dependent on the real experience and sensations of the individuals under consideration. Although we might be able to develop some rubrics for quantifying individual fulfillment at the population level, inevitably it is subject to

historical contingencies as well as the subjectivity of individual experience. Thus, it will change with time, and with the frame of reference, and as such represents a moving target. Returning to our world view and guiding principles (“Don’t assume that anyone knows what is best for someone else”) no one can dictate what peak fulfillment is, and especially not in a way that is true for all populations over all time. We must “embrace change” while looking to find a balance that is ecologically and economically sound and successful.

On Being The Right (Spiritual, Social) Size

J.B.S. Haldane was not only a brilliant geneticist, but renowned for his outspoken liberal and individualistic political beliefs. He wound up his final years in India writing in support of non-violence. Towards the end of his essay “On Being the Right Size,” he suggests that human societal structures also must have a proper or best size, saying that “To the biologist the problem of socialism seems largely a problem of size.” He closes by saying that “while nationalization of certain industries is an obvious possibility in the largest of states, I find it no easier to picture a completely socialized British Empire or United States than an elephant turning somersaults or a hippopotamus jumping a hedge.” Haldane, then, early on posed the intriguing comparison between the important constraints that size puts on physiological features of organisms, with similar constraints that might fall on societal/economic constructs as complicated as empire and government.

Softer social sciences and the harder “pure” sciences often find themselves in conflict. However, the deeper I think into sustainability issues, the more I become convinced, like Haldane, that positive and constructive solutions must take both types of approaches into account (Benz and Shapiro, 1998). Positivist hard data analyses, as outlined in this chapter, can help to identify where problems lie, and even suggest possible policy or personal-change solutions. However, the search and implementation for these solutions is rarely considered an appropriate part of the research program in the hard sciences. At the same time, constructivist solutions, based on social science and economics, sometimes fail to recognize

the real necessities that a particular sustainability problem presents, something that is best elucidated by a cold hard look at the numbers.

The lack of concordance and the rarity of instances where these two approaches are combined is, in part, due to confusing notions of what sustainability really means. Daly and Farley (2004) begin their discussion of scale from the premise that, as matter and energy cycle through the economic system, the desired product is welfare (Daly & Farley, 2004, Figure 2.3 on p. 18). They argue that economic systems should be designed at a scale where maximum welfare is produced. Throughout these chapters, I have proposed that sustainability is tightly tied to increasing individual-level life fulfillment. The economist's welfare, at the population level is, I believe, is a combination of survival and fulfillment. "Bad-fare," in turn, would then be a combination of death/extinction and suffering. If we begin with this view of sustainability, I believe it becomes possible to find a real role for both the positivist hard science approach that scaling analysis represents, and a softer, action-based search for solutions to the resource relationships identified as important trade-offs by scaling analysis

Size may be the original dilemma that all of us face. And its measure, the scale of things, is often incomprehensible. What teenager has not been overwhelmed by the idea of infinity or a limitless universe? How can we not be impressed by the scale of geological time and its fierce assurance that biological systems need no help in sustaining themselves over the long-long run? Who really knows whether more life satisfaction is to be found dancing at the tiny 10-cent juke-joint, or the five-story mega-discotheque? Humbling ourselves before these realities, we are most useful in limiting ourselves to analyzing how the range and scale of size that we can mostly comprehend—the size of individual organisms, the quantities of human populations and the extent of an ecosystem—might inform our best decisions for reducing current and future levels of human suffering. And what better instance to quest after these goals than in the start of a new human life, as we look at some real data in the next few chapters.

CHAPER SEVEN: Data for Pregnancy and Childbirth

Introduction to the data. Analyzing real-life economic and spiritual trade-offs in the start of a new human life.

Having established that individuals and populations within economies/ecologies maintain themselves by cycling energy over time, (understood as power use), and furthermore clarifying that power use can occur at only one level at any given time, we can now better analyze the kinds of real-world decisions and trade-offs that parents must face regarding their use of power in raising their children. Or, perhaps the process, as part of the self-regulation of a complex living system, is better understood as the constraints that the level of energy use puts on the kinds of activities and results families have available to them as they raise their children. All the data that are considered in the following chapters are aimed towards considering where the best level of power use, that might bring the wisest, most sustainable—in essence the highest level of true life fulfillment—can be found. High levels of performance—as represented by higher power use and often seen in Northern or developed-style populations—do not always result in the wisest use of power, or the highest levels of fulfillment. And in fact, for many critical child-raising practices and decisions, the way in which Southern, or less developed populations approach solving the inevitable dilemmas may teach valuable lessons to the North. Additionally, sometimes what is considered the ultimate “end game” or metric for success—enhanced survivability—might be one of the factors that is sacrificed, or for which there must be a trade-off, relative to higher levels of life fulfillment. For example, in the case of birthing practices, extreme high-cost, high-power-use interventions, such as emergency Caesarian sections, might increase survivability of mother and infant, but they come with the cost of sacrificing overall life fulfillment and satisfaction about the act of giving birth, whereas a low-cost, low-power-use “natural childbirth” approach might bring better results regarding the sense of life fulfillment.

The goal, then, for the second half of this work, is to look for how trade-offs in the level of power use—between spiritual metabolic levels and more economically-based higher levels—affect the options

that are available regarding specific child-rearing practices and behaviors. Starting with pregnancy and birth, each of the following chapters brings in-depth, real-world data to bear on specific variables that can be analyzed for their effect on individual life fulfillment and sustainability at different levels of power use, as represented by energy or money cycling. I've divided the start of life into three distinct phases, which form the sequence for the following chapters: Pregnancy and Childbirth (Chapter 7), Infancy and Toddlerhood (Chapter 8) and Early Childhood or the Pre-School Years (Chapter 9). Chapter 10 summarizes the data within the theoretical framework established in Chapter 1-6.

Three main sources of data were used (the details for data gathering and analysis can be found in Appendix One). First, anecdotal individual fulfillment data were gathered during several years of work and apprenticeship with Head Start and the public school district in Prescott Arizona and a similar time spent working with the equivalent government-funded early childhood program in Ibarra-Ecuador, the INFA (*Instituto de la Niñez y la Familia*) pre-schools. Then, quantitative data for the same early childhood school populations were culled from standard interview and evaluation instruments that were administered over several years. These data were compared with similar quantitative data from the Millennium Cohort study, a massive-scale, British government study of early child development. Finally, national-level statistics among many countries of the world were gathered and analyzed from numerous online sources for appropriate variables that contribute to the understanding of the trade-offs under consideration.

Pregnancy and Childbirth

Pregnancy and childbirth sets the stage for how a child is to be raised. A family's decisions at this time already reflect the resources—economic and spiritual—that they have available. And increasingly we are aware that the mother's actions and behaviors, along with the social and physical environment in which she lives, can have profound effects on the child's growth and development. And of course birth is a crucial time when the baby makes the transition to the world of sound, light and air, establishes its first bonds, and begins breathing and feeding outside the womb.

In this chapter, I compare tradeoffs between fast-cycling, high-level power use and slower-cycling, lower power use approaches to pre-natal care, and then childbirth. The level of power use in these activities has a great effect on the way they are carried out and the kind of results that are obtained. Contrary to common publicly held notions about pre-natal care and childbirth, more money and energy spent on these activities does not always lead to better results, even in that most basic of metrics for success—survivability as measured by infant mortality rates. When we delve deeper into life fulfillment for the families involved, we also see that increased expenditure of money and energy often lead to higher levels of stress and lower life fulfillment.

Trade-offs regarding Pre-Natal Care

Most mothers in Ibarra, Ecuador seek pre-natal care from the traditional allopathic-based health care system (approximately 90% of the INFA government-run day-care population receives pre-natal care). A slightly larger percentage (97%) of the Northern Arizona Head Start mothers seeks pre-natal care from the corollary system in the U.S. The following typical accounts of a pre-natal care visit are based on interviews and anecdotal evidence from dozens of mothers at the government-run pre-schools in Ibarra-Ecuador and Prescott, Arizona.

Anecdotal evidence—Ibarra, Ecuador

In Ibarra, mothers typically seek pre-natal care, on a drop-in basis, at a local neighborhood community clinic, or one of the paid private clinics in the city center. Increasingly families have a privately owned automobile, but most mothers still seek care at the closest clinic, or one that is easily accessible by bus. Most families choose their clinic on the basis of ease of access, and recommendations from other family members or friends. Whereas the neighborhood clinics do not charge for services, the private clinics charge the equivalent of a one-day minimum-wage salary for a standard pre-natal care visit, which always includes ultra-sound imaging of the fetus. In both cases, the same primary care

physician or obstetrician will see the mother for each follow-up visit and these are recommended once per month throughout the pregnancy.

The typical visit is not very different at the community and private clinic, although the private doctors usually have more experience since most of the public clinic doctors are recent medical school graduates fulfilling a government service requirement. Although they may have less experience, they might be more up-to-date and more enthusiastic in their work since they are recently entering the profession. In either setting, the doctor is usually the sole health care professional present and does everything from weighing the patient to imaging the fetus.

The visit starts with a casual interview, carried out in the desk/office area of the clinic, where the doctor inquires about anything unusual that might be bothering the mother. If the mother reports any emotional or psychological symptoms, the doctor tries to allay them since they are most commonly related to fear about the pregnancy or childbirth. Then, the doctor takes the patient to the examination part of the clinic, usually in the same room, and performs a physical exam. This includes taking vital signs, palpating the abdomen and looking at hands, feet and the rest of the mother's body for any unusual signs. Next, the baby is imaged using a bedside ultra-sound machine. Appropriate anatomical milestones are noted on the ultrasound examination and measurements of total fetal length, skull and femur length, and other features are taken. These measurements are then compared with the expected growth curves, based on Ecuadorian averages, for a fetus at that stage. These results are relayed, verbally, at that moment, to the mother and she usually gets a print-out of the fetal image. At the end of the visit, the doctor recommends any medications, vitamins or blood tests if they are deemed necessary. For pre-natal care, it is unusual that anything is prescribed. If it is, the pharmacy and lab located in the clinic can provide these services or products at the same price as they would be obtained anywhere else. Payment for the doctor's services at a private clinic is made at the end of the visit, either directly to the doctor, or to their secretary.

At some clinics, an appointment is made for the follow-up visit, but most doctors see all their patients on a walk-in basis. Waits are usually not longer than half an hour, but if a large number of

patients happen to show up, then the secretary can suggest a better time to return when the doctor will be less occupied. Private clinic doctors typically maintain an electronic medical record on their own clinic computer that can be accessed from visit to visit. Community clinics are more likely to have a paper file for each patient. The patient never fills out any forms or signs any documents during their entire health care experience in an Ecuadorian clinic. Most mothers report high levels of satisfaction with their pre-natal care and the pre-natal care provider. As one mother said,

Amo a mi doctor. El hace todo para mí. Llego y ya me está esperando. Sabe preguntar de mí y mi bebé y mis otros niños. Después hace un examen suave y me hace ver en la pantalla como está mi bebé. Al final, si tengo algún problema, le cuento y me hace sentir bien. No tengo ningún problema, gracias a Dios, y ya me falta poco. [I love my doctor. He does everything for me. I arrive and he is usually waiting for me. He knows to ask about my baby and my other children. Then he does a soft exam on me and lets me see my baby on the screen. If I have some problem, I tell him and he makes me feel better. I don't have any problems [with my pregnancy], thank God, and now I have just a short time to go]

Anecdotal evidence—Prescott, Arizona

Most mothers and families in Prescott, Arizona begin seeking pre-natal care with an Internet search or phone call, often after consulting with friends and family-members about their experiences, or perhaps consulting with their primary care physician. Most insurance plans require a referral from the primary care physician to see the pre-natal care provider for the first time. The location of the clinic is not usually considered an important choice factor, and some mothers travel in their private car to neighboring towns, sometimes as far as 20 miles, to see their pre-natal care provider.

Most commonly, those mothers who seek pre-natal care go to a multi-doctor obstetric practice, although a small percentage (less than three percent) go to a mid-wife. The first pre-natal visit is scheduled with a phone call and most obstetric practices have at least a 2-4 week wait time to get an appointment. On the day of the appointment, the mother is asked to arrive one-half hour before the appointment time to fill out paperwork, which includes several pages of forms regarding the patient's personal information, medical history, insurance coverage and legal waivers. After filling out paperwork, typically patients wait 15-45 minutes before their appointment begins.

In the first appointment phase, a nursing assistant takes the patient's vital signs and physical measurements and the patient is then moved into an examining room. After another wait in the examining room, a nurse asks many of the same medical history questions that are already filled out on the initial forms and enters them into the clinic's computer system, starting an electronic medical record which is always backed up by a paper record in a cardboard folder. After another wait, the obstetrician, who is typically one-half hour to one-hour behind in their appointment schedule, comes into the examination room, often displaying a rushed demeanor with the patient. They may ask many of the same questions that the nurse has entered into the medical record. Some doctors are said to be quite friendly, while others seem relatively uninterested in the patient. At some obstetrics practices, the same doctor sees the mother throughout pre-natal care, while at other practices it can be a different doctor at each visit. Most doctors end the patient interview by asking if the mother has any complaints or anything unusual to report.

Physical exams are done at approximately every other pre-natal visit. They usually consist of measuring and palpating the abdomen. At three different points during the pregnancy, the mother is sent for an ultra-sound image. This is sometimes done at the same clinic by an ultra-sound technician, but more often involves scheduling a separate appointment at a medical imaging facility. Although the technician may be able to say some things about what they see in the image, and they will often provide a printed copy of the image, the mother is always told that a full report will be provided by their obstetrician at the next visit, or more quickly if anything abnormal is found. Most doctors prescribe vitamins throughout the pregnancy, usually with a prescription, that can be bought at a pharmacy, but are never available at the clinic. In many cases, if the mother reports any kind of emotional or psychological symptoms, the obstetrician recommends a follow-up appointment with the primary care physician, or a specialist.

At the end of the visit, the patient must check out at the reception area, usually sign another check-out document, and pay any co-payment fees to the billing specialist, or if uninsured arrange for payment. If paying out of pocket, the charges for a typical pre-natal visit with ultra-sound image are four

to five days of average wages for a minimum-wage worker. Approximately half of mothers report dissatisfaction with their pre-natal care or their pre-natal care provider. As one mother said,

I'm not even sure who my doctor is. I am always calling and then waiting for an appointment and then they are never on time for their appointment, even though she [the receptionist] tells me to never be late because they will charge me anyways. The doctor is pretty nice usually, but it's all the other nurses. They take you through like a factory and the waiting room doesn't even have any toys for my other kids. Last time, when I had my baby at the hospital, the doctor never showed up. I think it was just the interns at the hospital..it happened so fast. This time, I know I have to tell them to let my husband come in and be with me, and my mother, too. I just hope they don't cause me too many problems in the hospital and that the insurance pays for it all.

Local population quantitative data: Income, urban-ness and percent of pre-natal care in Ibarra, Prescott and England

The government-run day care population of families in Ibarra and Prescott both exhibit a wide range of incomes and the centers are located from relatively urban areas into quite sparse rural zones (see Figure 14). In both countries, relative income is much higher in the urban areas (approximately double the more rural average income). Absolute income among the Prescott sample is approximately 4-5 times greater than among the Ibarra sample. Neither population was queried for data regarding their pre-natal care or satisfaction with that care in any quantitative way.

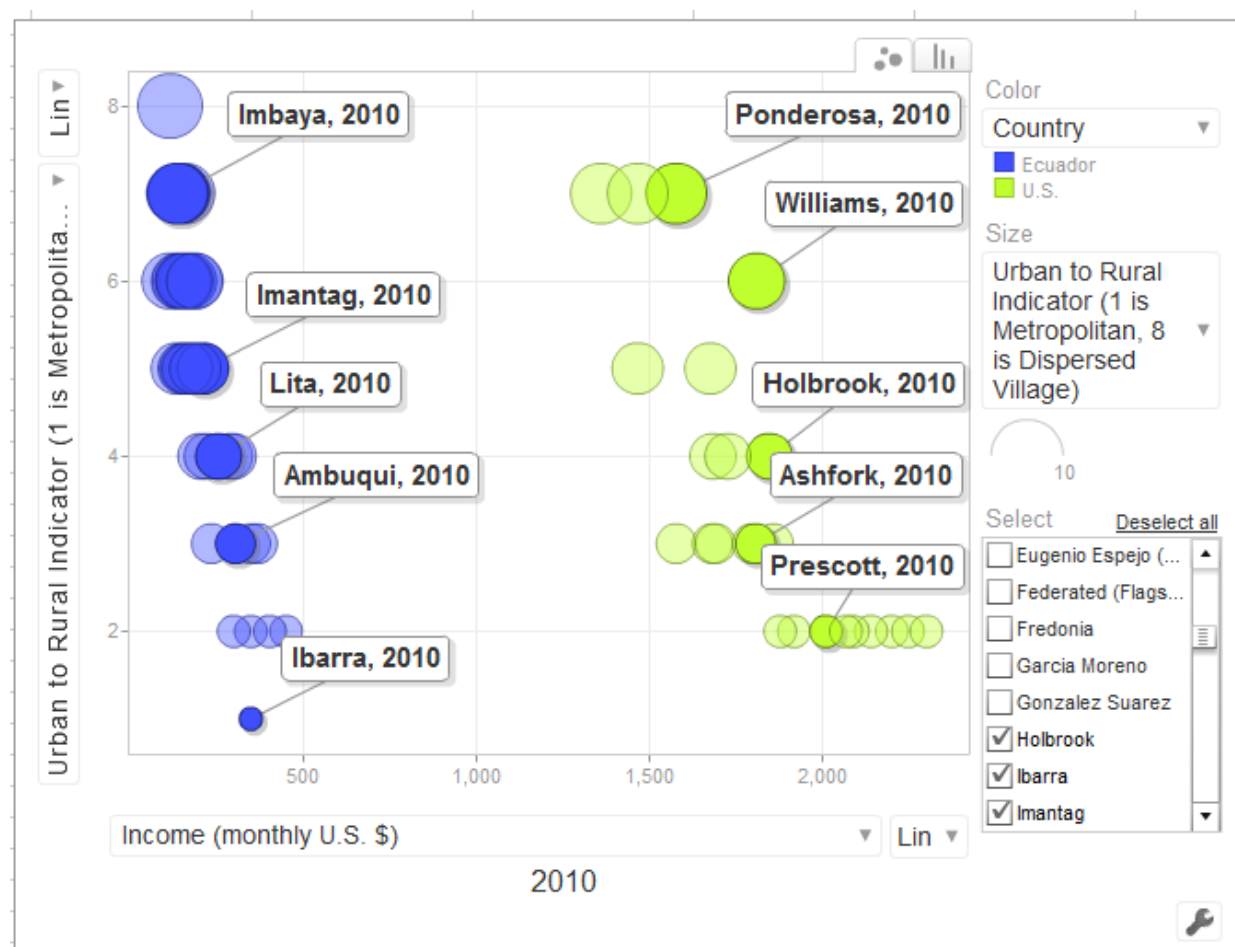


Figure 14. Income versus urban/rural location for government-run pre-school families in Ibarra, Ecuador and Prescott, Arizona. Both programs run centers that serve populations from very urban to very rural. Income level tends to be higher at the urban centers. Income averages, at a given level of urban-ness, are four-five times higher in the U.S. than in Ecuador. Sample center names that include the most well-known cities and towns, are indicated at each level of urban-ness.

For the British Millennium cohort families, rural families are relatively wealthier (see Figure 15). This reflects, I believe, a unique characteristic of British social structure and its relative antiquity. Rural settings in England were traditionally the home for the wealthier, noble class and the high wealth of the British country-side, compared to urban centers, to this day reflects those differences. Also, the sample for the Millennium Cohort study includes all families, not just those who use government-run pre-schools, which tend not to attract higher-income families as their clients. In the U.S. and Ecuador, some rural large-scale land owners (“*hacendados*” in Ecuador), as well as wealthier suburban families, could

skew higher incomes into the rural areas. However, in the U.S. and Ecuador, the higher-income suburban and rural families are very unlikely to use a government-run pre-school center like Head Start.

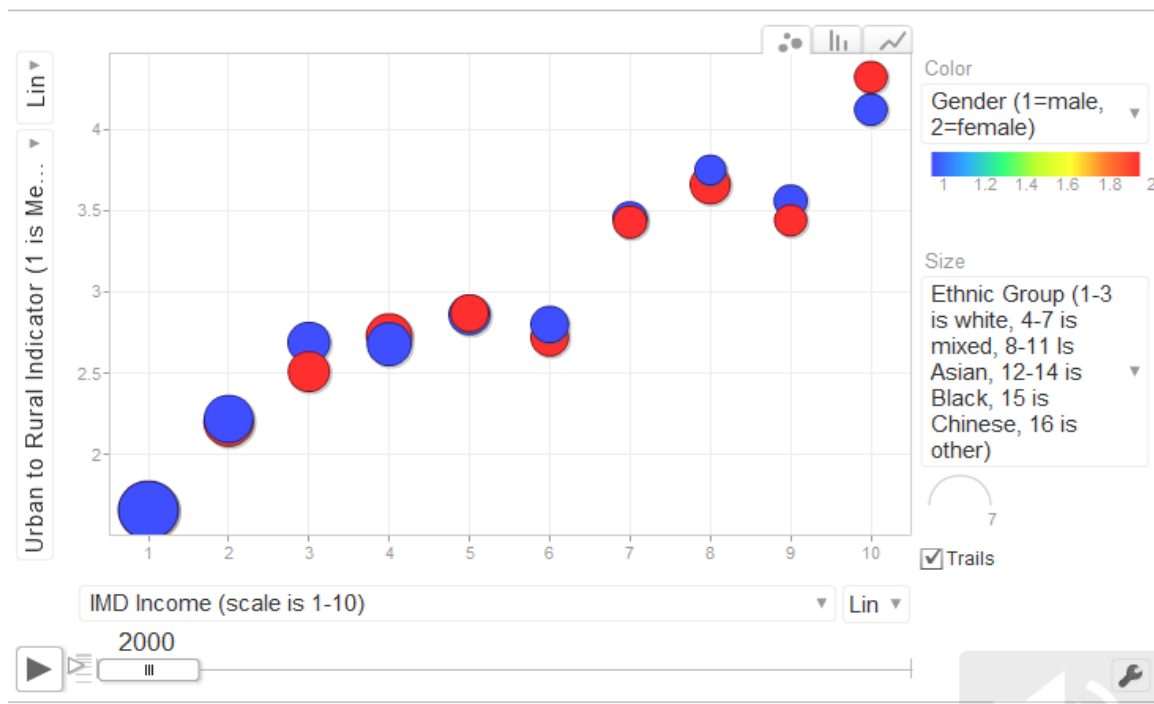


Figure 15. Income versus urban/rural location for the British Millennium Cohort Study. Rural areas tend to be wealthier, in stark contrast to the data from U.S. and Ecuador family. The size of the dots indicates the ethnic diversity at each income level. The y-axis indicates the level of urban-ness (from more urban to more rural) at each income level. Each income level is separated into male and female sample sets (based on gender of the baby/child in the study) to facilitate analysis of later data. For these variables, the male and female babies' families are very similar and when the dots perfectly overlap, it's not possible to see the underlying red dot representing the female average.

In the British Millennium study, 97% of the families received pre-natal care (Dex and Joshi, 2005). Young mothers, Bangladeshi and Pakistani mothers were the most likely to begin post-natal care after week 16, which is defined as “late,” or never receive pre-natal care. These same populations are also lower income (see Figure 16). These results, along with the anecdotal evidence from Ibarra and Prescott, suggest that lower income families might be less likely to receive timely pre-natal care (Figure 17). However, all three countries—Ecuador, U.S. and Britain—have very high rates of pre-natal care. Quantitative indicators of satisfaction with the pre-natal experience relative to income scale were not available for any of these populations, nor were levels of pre-natal care compared with success in terms of

infant and mother survivability. However, suggestive data are available at the national level from around the world.

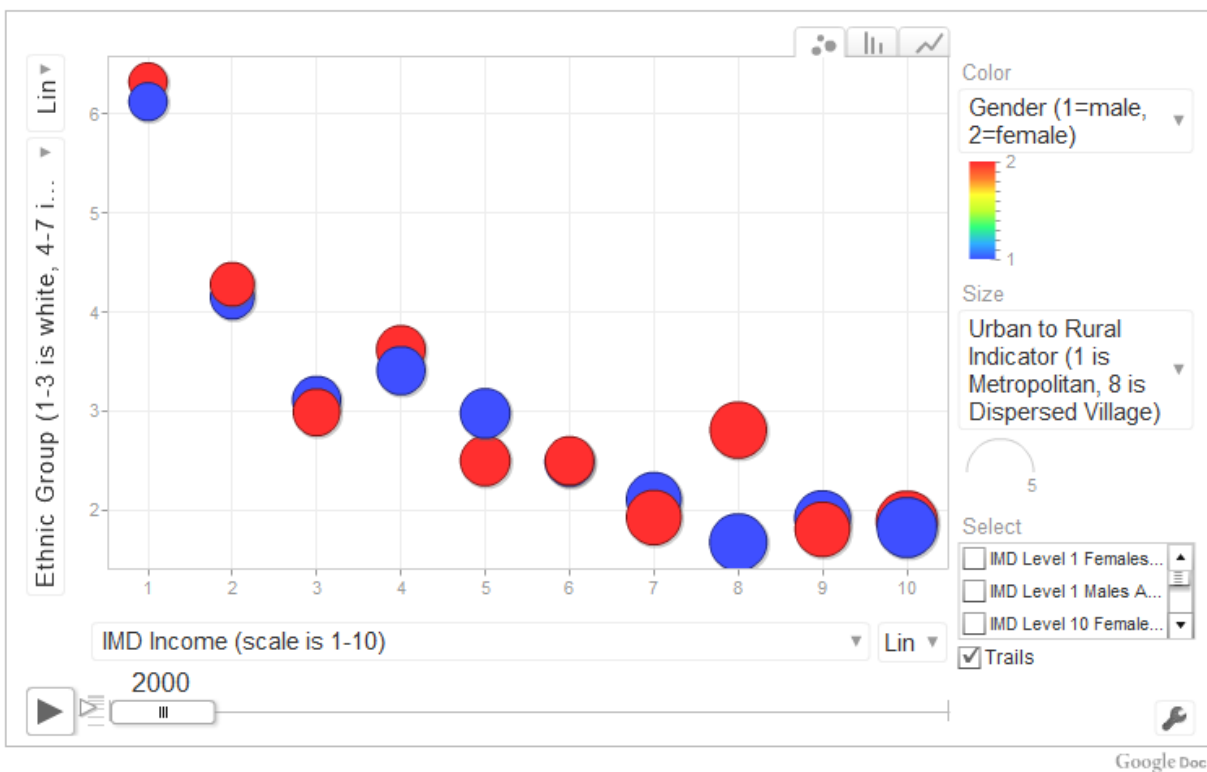


Figure 16. Income versus level of ethnicity among the British Millennium Cohort study. Lower income populations tend to have a higher portion of non-white families, most of which are Pakistani or Bangladeshi.

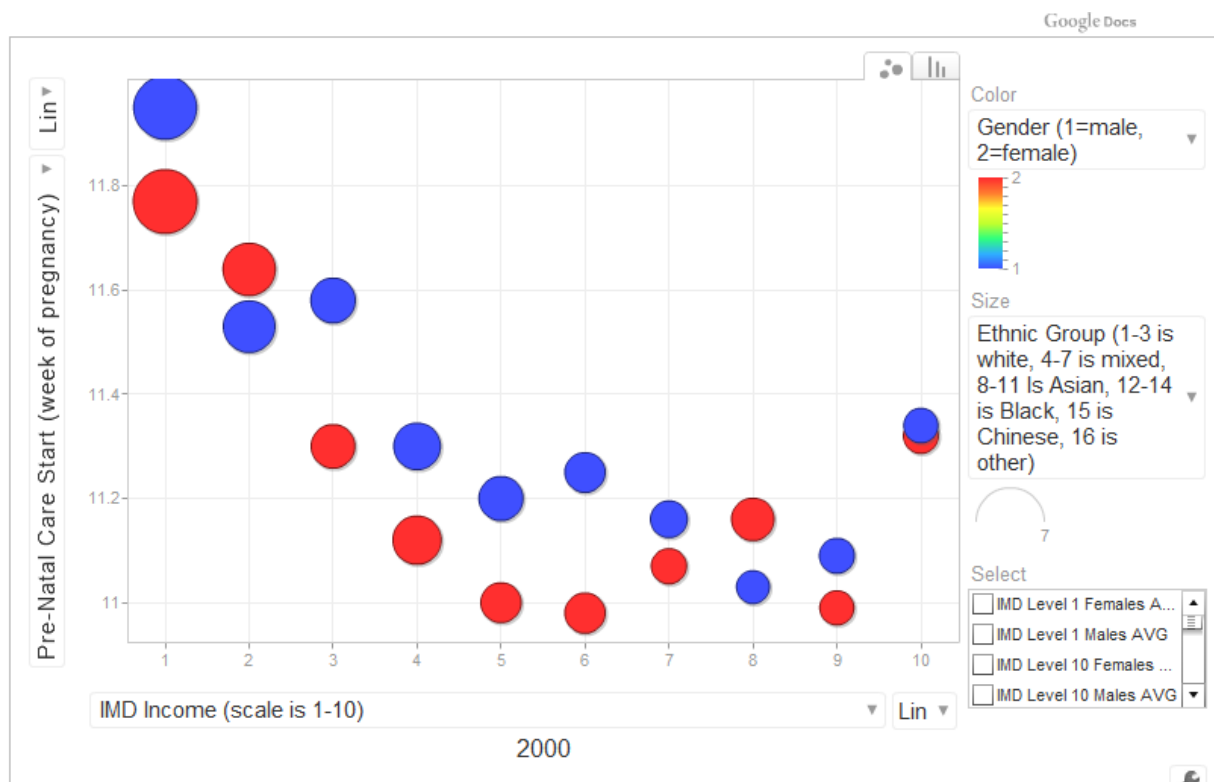


Figure 17. Income versus week that pre-natal care was started among the British Millennium Cohort study. Higher income populations tend to start pre-natal care earlier. This also correlates with level of ethnicity with lower income populations showing a higher ethnic mix and a tendency to start pre-natal care later. However, virtually the entire population received pre-natal care (98% in England) and the variability among start-dates is low from 11th week to 12th week. By the end of the first trimester, then, every population, on average, has begun pre-natal care.

World data—pre-natal care and infant /mother survivability

National levels of pre-natal care world-wide are consistently high (Figure 18). For the northern countries, including Asia east to China, rates are 90% and above. On the Indian sub-continent and some countries in Africa, rates dip lower but still remain at 70% and above. The countries with very low (less than 50%) rates of pre-natal care tend to be dominated by war-zone, such as Sudan, Niger, and Afghanistan. Governments and international organizations have long recognized that providing pre-natal care is an important step towards reducing infant and birthing mother mortality rates (Harris, 1982, World Bank, 2003). Thus, in conjunction with higher rates of pre-natal care, world levels of infant mortality are

significantly reduced, and the large gap between so-called “developed” countries and “non-developed” countries has been dramatically reduced, except for much of sub-Saharan Africa.

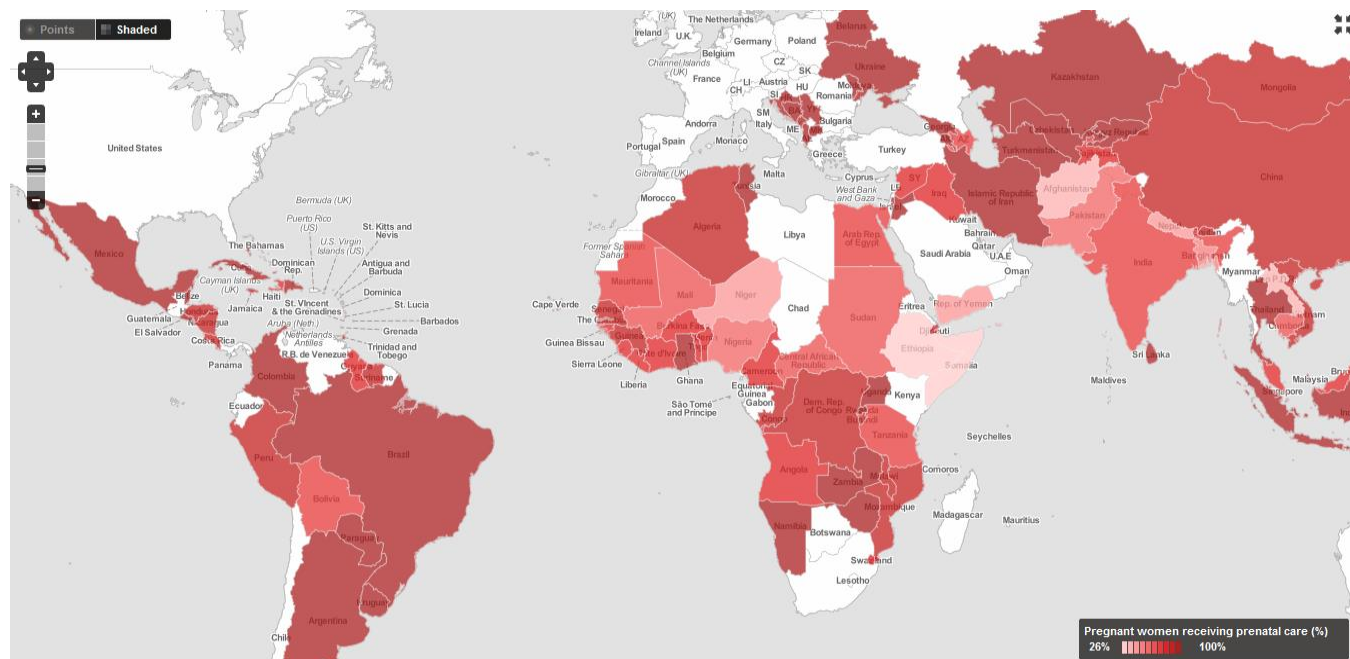


Figure 18. Word levels of pre-natal care. Data are from the World Bank (<http://data.worldbank.org/indicator/SH.STA.BRTC.ZS/countries?display=map>) for most developing countries. Countries in white have no data available. For Europe and North America, rates would be very close to 100%. In general, levels are high world-wide with low pre-natal countries (less than 50%) affected by war, such as Afghanistan, Sudan and Niger.

Low infant mortality rates (see following section) are important for success, in terms of survivability, and they must affect the sense of life fulfillment, since losing a child must be one of the most painful human experiences. However, much of the world, outside sub-Saharan Africa now experiences very low infant mortality rates (Figure 19). The marginal “advances” in infant mortality rates seen in Europe and North America probably come from high-end, technologically-based birth interventions, which we talk about below. Although it may be considered heretical to question whether lower infant mortality rates are not always better, the marginally lower rates, seen in Europe and North America relative to South American and most of Asia, must be further considered for their potential to detract from life fulfillment. Once relatively universal levels of pre-natal care are achieved, then the

quality and nature of that pre-natal care should be considered. In particular, the use of trained midwives may represent a lower-energy approach that actually provides better quality of life and sense of fulfillment for expecting families.

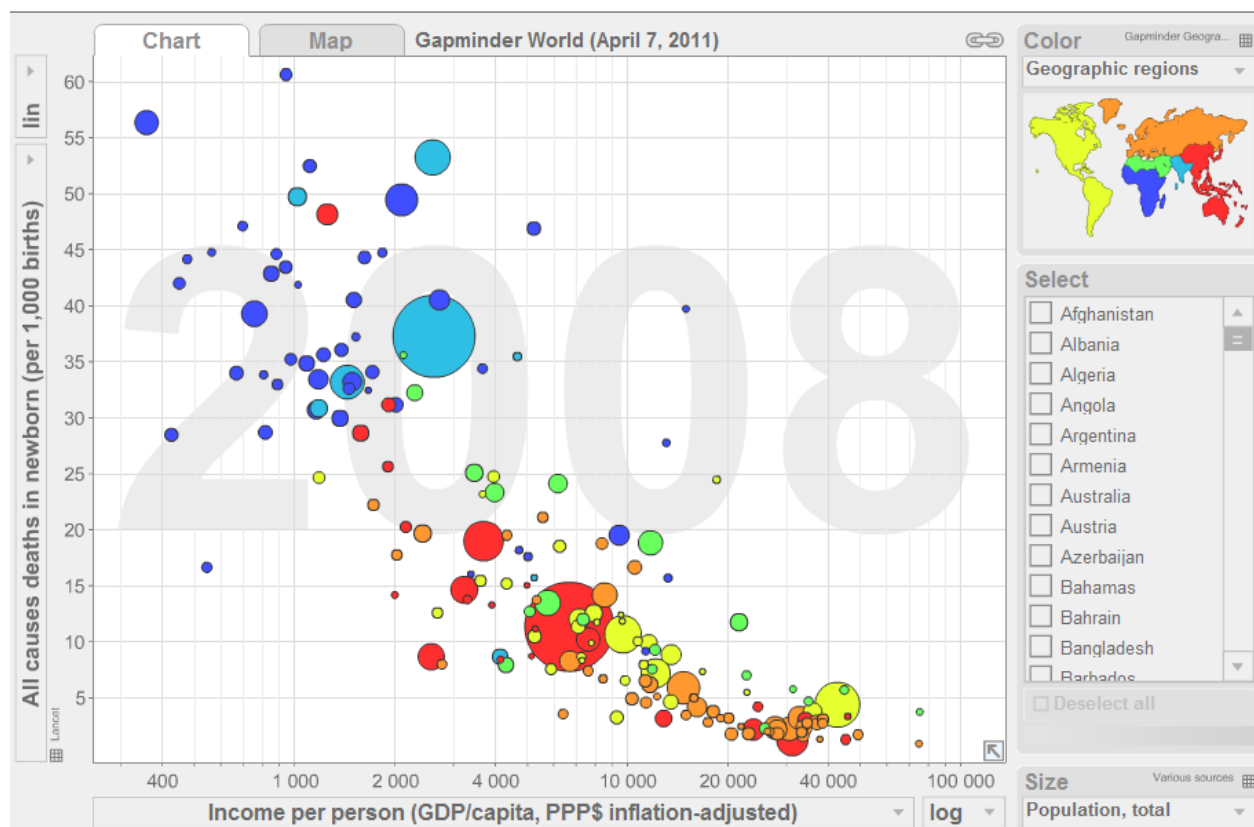


Figure 19. Infant mortality among newborns versus per capita GDP for most of the countries of the world. Except for sub-Saharan Africa, most of the world is at less than 15-20 deaths per 1000 births, and really most countries are close to 5 deaths per 1000 births. The marginal differences between countries at 5, and those at 10 deaths per 1000 births should be further analyzed for their overall quality of prenatal and birthing care, and the effect that care has on maternal and family sense of life fulfillment.

In an in-depth comparative study of the U.S., United Kingdom, Canada, The Netherlands, along with additional data from other European countries shows that the typical obstetric experience is neither more successful, in terms of infant survival, nor more fulfilling, in terms of maternal satisfaction. In The Netherlands, over 70% of mothers are now attended by trained midwives and give birth at home. This represents a new sea-change in birthing and pre-natal style away from mainstream medical practice, which itself was recently introduced as the gold standard for birthing practices within the last 100 years.

What The Netherlands, as a country has realized, along with certain fringe segments of the population in the U.S., Canada and United Kingdom, is that medicalized pre-natal and birthing care is not necessary for the large majority of pregnancies. The authors of the study, *Birth By Design* (deVries et al., 2001), title their introduction “Why Maternity Care is Not Medical Care?” and they make the point that the gap between midwives and obstetricians is not simply a data-based gap, or a practice-based gap, but one that involves the core of who we are as humans, what cultural beliefs we maintain, and all in reference to the most fundamental of activities—how will we reproduce and initiate the start of a new life (as individuals) and a new generation (as a population).

The use of trained midwives for pre-natal care in economically advanced Northern countries represents one of the greatest trade-offs regarding energy use and life fulfillment or sustainability. The lack of satisfaction with their pre-natal care expressed by the Head Start mothers in Prescott, Arizona suggests some serious problems with typical obstetric practice. Furthermore, the cost of that care is exorbitant, and mostly spent on organizing the bureaucracy of providing care, and the technological interventions that the care itself involves. Midwife care, however, as practiced in the Netherlands, starts at a spiritual-level use of power, with a relatively small bureaucratic infrastructure and health care providers who use a minimum of technology, but are trained to orient expectant mothers to the physical and emotional changes that accompany their pregnancy and the upcoming birth. Even traditional obstetric standards of care recognize that social-emotional care and education are the most effective components of pre-natal care (Banta, 2003):

The basic [most effective] activities of antenatal care fall within three general areas:

1. screening for health and socioeconomic conditions likely to increase the possibility of specific adverse outcomes;
2. providing therapeutic interventions known to be beneficial; and
3. educating pregnant women about planning for safe birth, emergencies during pregnancy and how to deal with them.

And yet these are the areas in which a typical obstetric surgeon (yes, all obstetricians are initially trained as surgeons) are least likely to excel.

Pre-natal care tradeoffs—conclusion

In the case of pre-natal care, the trade-offs between power use or cost with a result that brings enhanced life fulfillment are clear. The desired sustainable, peak-fulfillment behavior is to be found at a balance-point where pre-natal care is available universally, but in a form that is sympathetic to the social, emotional and educational needs of the mother. On the one hand, overly low levels of pre-natal care lead to high infant mortality, at a population level, representing many families who must cope with the overwhelming pain of losing a child. Once high levels of pre-natal care achieved, the over-application of high-technology, and regimented bureaucracies may lead to a lessening sense of satisfaction on the part of mothers receiving that care, and a loss of focus on the mother, and her social, economic, emotional and educational needs regarding the pregnancy. Here, the power cycling, or expenditure of resources, has moved to such a high level that it is no longer effective in terms of providing enhanced life fulfillment for an expectant parent. It may be difficult to ask, or even require, the existent obstetric care system to return to a lower level of power use and this is one of the risks that resource-rich self-regulating systems carry. However, the existent of a parallel, lower-energy midwife care system in most developed countries provides a more life-fulfilling, and sustainable, alternative. The Netherlands represents a model example where national emphasis on that system has led to its widespread implementation. Whether a repetition of The Netherlands example is possible in other countries, where the obstetric system may be more fully entrenched, remains to be seen.

Tradeoffs regarding childbirth

Among all the mothers who were interviewed or told their stories in Ibarra-Ecuador and in Prescott, Arizona, only the private-clinic patients in Ibarra-Ecuador had their births attended by the same doctor who provided pre-natal care. In both cities, almost all mothers (more than 98%) had their births in a hospital, or hospital-like clinic setting.

Anecdotal evidence—Ibarra, Ecuador

In Ibarra, Ecuador, the private clinics have a hospital-like in-patient facility attached to the doctor's offices, where births are attended. The same obstetrician who provided pre-natal care will almost always attend the births of their patients. The neighborhood clinics do not have in-patient services and mothers typically go to the public hospital in the city center for the birth, which is attended by one of the staff doctors. When a laboring mother arrives at the hospital or clinic, she is taken directly to the maternity ward and no paperwork is required at that time.

During labor at the private clinics or public hospital, mothers are usually in a private room (clinic) or open ward (public hospital) with family members accompanying them. They are encouraged to walk about, to drink water, or to perform whatever activities will soothe them and to get into whatever position will help ease the pain. They are never tethered to an intravenous line or a fetal monitor. Sometimes one early-labor cervical exam is performed, but most often nurses, and the attending doctors seem to have a natural sense for when the mother is nearing birth. It is well accepted that labor might last from a few hours to a day or two.

As the moment of birth approaches, the mother is taken to a birthing room. Until recently, the birthing table was frequently set up for the mother to be on her back in elevated stirrups, but this practice is changing, and the birthing rooms now provide for any position that the mother finds comfortable. The emergency equipment available in a birthing room is similar to what might be found in a U.S. community hospital, according to anecdotal evidence from several obstetricians with experience in both settings.

Very few mothers have any drugs administered during labor or childbirth and rarely are any kind of devices used to help with fetal extraction. Episiotomies are occasionally performed. Caesarian sections are very rare and usually done only when the mother or baby is in grave danger.

Immediately following birth, an attending pediatrician assesses the baby's Apgar score. The umbilical cord is tied and cut and silver Nitrate eye drops are administered to the newborn baby to prevent infection by bacteria that could lead to blindness. These initial care steps, are all done at the mother's

bedside unless there is some indication that the baby needs further care, such as suctioning of the lungs. The baby is swaddled in towels or cloth diapers provided by the mother's family. The baby is given to the mother and breast-feeding usually begins soon after birth. The baby and mother are taken together, on the same gurney, back to their room or the labor area ward. Family members are present to help the mother in recuperation. If she spends the night in the hospital, she and family members will all be together, with both mother and baby sleeping in the same bed, as will be the case when they return home. It is expected that any and all family members will hold and carry the baby in the hospital.

Upon leaving the hospital, the nurse on duty will fill out the mother's personal information on a birth certificate form which can be presented to obtain a national identity card for the baby at a later date. If the family is paying out-of-pocket at a private clinic, total charges for a routine birth will be approximately equivalent to two weeks of minimum-wage salary.

Some mothers in Ecuador, especially those who live in more rural communities outside the city, give birth at home attended by a family member. In these cases, home remedies to comfort the mother, including compresses and teas, are frequently the only care that is provided. The mother herself, or an attending female family member, receives the baby and ties and cuts the umbilical cord. The baby is immediately passed to the mother following birth and usually begins breast-feeding right away.

Anecdotal evidence—Prescott, Arizona

In Prescott, Arizona, most births take place at the local community hospital. Check-in begins in the reception area. Admittance paperwork, involving numerous forms, is filled out by the mother if she is capable, or a family member. If the mother is in advanced labor, she may be taken directly to the maternity ward, or a birthing room.

Most mothers stay in a private room during labor. Nursing care is mostly technical involving repeated measurements of mother's and baby's vital signs, cervical exams to check dilation and frequently the initiation of an intravenous drip and an attached fetal monitor that the mother wears around her belly. If one of the obstetricians from the mother's pre-natal care provider is in the hospital, they may

visit the mother once or twice during labor. The nurses and doctors all have a constant concern that labor is progressing and they are anxious for the baby to be born in a minimum of time. Although recently mothers are allowed to walk about, they are generally encouraged to remain in bed and are frequently offered an epidural anesthetic if their pain seems unbearable. If the epidural is administered, the mother would then have a second drip-line that is inserted into the lumbar spinal region and would be unable to move about freely. If labor continues for a period of time that the nurses or doctors deem inappropriate, they may administer pitocin to enhance contractions and speed up the birthing process.

Once cervical dilation reaches a certain size, the mother is transferred to a birthing room. A surgically suited hospital intern doctor is usually present throughout the time that she is in the birthing room, along with one of the obstetricians from the pre-natal care practice. The birthing room has a stirrup position bed, but this is not usually used and the mother is encouraged to find her own comfortable position, often sitting or leaning in the bed, to give birth. Family members are allowed to be present if the mother has provided previous written authorization.

If the “pushing” phase of labor continues beyond a certain time period, or if the doctors become concerned that the mother is becoming too tired, then they may take steps to hurry the birthing process. This may include administering pitocin or rupturing the amniotic membrane. After membrane rupture, if it appears the baby is still not moving rapidly through the birth canal, forceps or a suction cup device might be used to try and manipulate the baby through the canal.

Caesarian sections are common at the community hospital in Prescott, Arizona and reflect national U.S. rates of about thirty percent of all births. The decision to do a Caesarian section might have been taken before labor if the mother presents any risks, such as a breech position, previous Caesarian birth, previous abdominal surgery, late-in-life pregnancy, or early-in-life pregnancy, among others. During the labor process, if the mother appears exhausted, or the fetal monitor suggests any abnormalities in the fetal heart rhythm, then the decision might be taken to perform a Caesarian section.

Immediately following birth, the umbilical cord is cut and the baby is taken to an examination table on the other side of the birthing room. It is wiped down, the Apgar score is measured and an

antibiotic eye salve is given to prevent infections that could cause blindness. The baby is foot-printed, a hospital tag is put on its wrist and something is usually done to stimulate crying if it is not yet crying. In some cases, a Hepatitis B vaccine may be administered. At the mother's request, the baby may then be returned to the mother's bed. Rarely is breast-feeding attempted at this time.

After a period of recuperation in the delivery room, usually one-half to one hour, the mother and baby are transferred back to the mother's labor room. The baby must be transferred in a clear plastic rolling bassinet separate from the mother who is on a gurney. Unless the mother requests otherwise, the baby is then put on a feeding and visiting schedule. When not in the mother's room, the baby is in the maternity-ward nursery with other recently-born babies. Breast-feeding is verbally encouraged, but most mothers choose to start formula-feeding in the hospital and this is frequently done by the nurses. Family members are allowed to visit and stay in the hospital, but the baby is not allowed outside the nursery or the mother's room, and must always be transported in a rolling plastic bassinet where it sleeps and spends most of its time in the hospital.

At check-out, the mother fills out numerous forms, including the documents that are sent directly to the state records office to issue a birth certificate and to the social security office to issue a social security card. If the mother has not yet chosen a name for the baby, these documents may have to be corrected at a later date. Payment arrangements would have been made upon check-in to the hospital in most cases. If the family is paying out-of-pocket, total charges for a routine birth will be approximately equivalent to two months of minimum-wage salary.

Local population quantitative data

For the Ibarra and Prescott pre-school families, no quantitative data are regularly gathered regarding birth. However, for the British Millennium Cohort Study (MCS), statistics regarding birth practices, complications, birth weight and who was present at birth were gathered (Jayaweera et al., 2005).

Very few mothers in the MCS gave birth with no family members present (less than 4% of the total sample). In 86% of the sample, the father was present, and in 16% of the families, the mother's mother or

mother-in-law was present. Among ethnic groups, Black African and Caribbean mothers were more likely to have no family members present, and correlated with the high level of single mother-hood, fewer fathers were present at birth. However, Black mothers, as well as Pakistani mothers, are most likely to have their mothers or mother-in-laws present.

Regarding the birth itself, around 30% of the total sample mothers were induced, according to the mothers. The medical definition of induction includes rupturing the membranes or administering oxytocin or some other drug to initiate labor. However, the rates reported in the Millennium Cohort Study may be too high since mothers probably report the speeding up labor or other non-induction interventions as induction. Official government statistics suggest that 21.5% of hospital births in England involve induced labor (DH, 2003). Mothers of mixed ethnic origins are most likely to be induced (almost 50%) compared to 30-40% in other groups. Indian mothers are less likely to be induced at about 23%.

Approximately 67% of the mothers had an unassisted vaginal birth. Among the remaining mothers, 10% had an assisted vaginal birth, usually with a vacuum extractor, and 22% had a Caesarian section. In England, as in the U.S. and many other countries with high levels of health care access (McCourt et al., 2007), Caesarian section rates have risen dramatically in the last half century. In the 1958 British cohort study, only 2.7% of the mothers had Caesarian sections, and in 1970 the rate was 4.5%. Of the 22% of mothers that had Caesarian sections, 9.2% were elective, or pre-planned, and the others were emergency, or unplanned, Caesarian sections.

The length of stay in the hospital, for mother and for baby, are good indicators for the level of interventions and complications with the birth. The length of stay shows no trends associated with income level, suggesting that a similar level and type of treatment is provided regardless of income level (Figure 20). This may be especially true under England's government-run health care system, but is probably typical of birth care in Northern countries, and increasingly in all parts of the world (except sub-Saharan Africa) where most birth settings have fully trained obstetricians and equipment available for all patients.

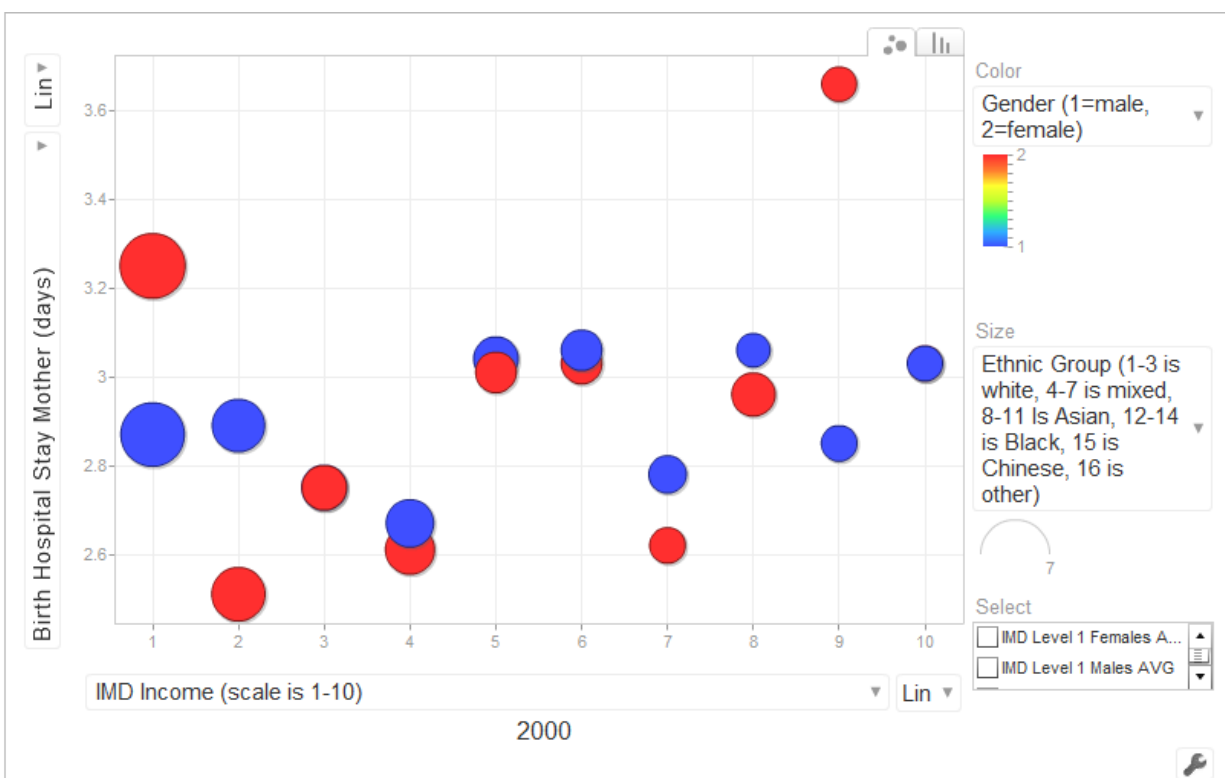


Figure 20. Income versus length of birth hospital stay for mother in the British Millennium Cohort study. There is no obvious trend for length of hospital stay with income group, suggesting that all mothers are receiving similar types of care and similar levels of intervention.

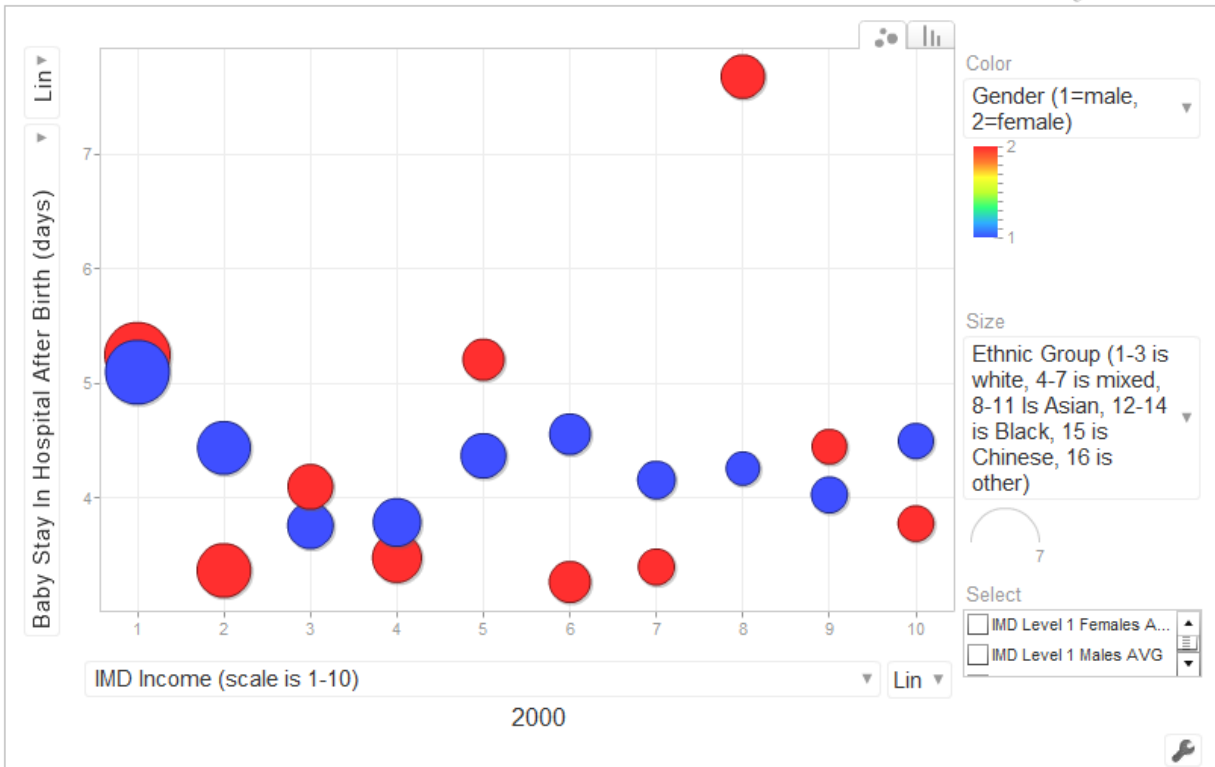


Figure 21. Income versus length of stay in hospital following birth for babies among the British Millennium Cohort study. There is no obvious trend for length of hospital stay with income group, suggesting that all babies are receiving similar types of care and similar levels of intervention.

Birth weight among the MCS populations shows a clear trend for higher weight babies among higher income classes, and higher weight for males than females within each income class (Figure 22). This may reflect the inheritance of smaller size for babies in lower income families who parents are from the Indian sub-continent and tend to be smaller. Birth size seems to have no effect on baby health, as indicated by length of hospital stay. By two years any income differences in the cohort size are gone (Figure 23).

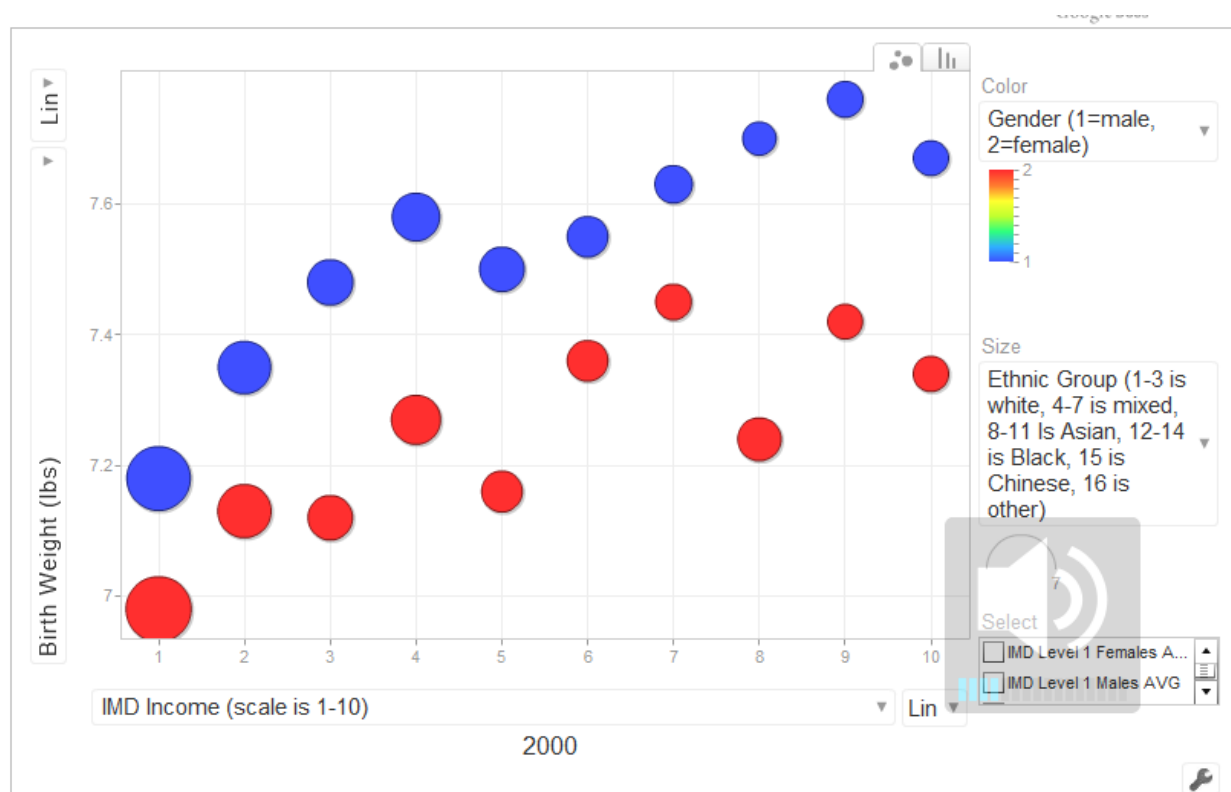


Figure 22. Income versus birth weight for babies in the British Millennium Cohort study. Higher income populations have higher birth-weight babies and males within each income class weigh more than females.

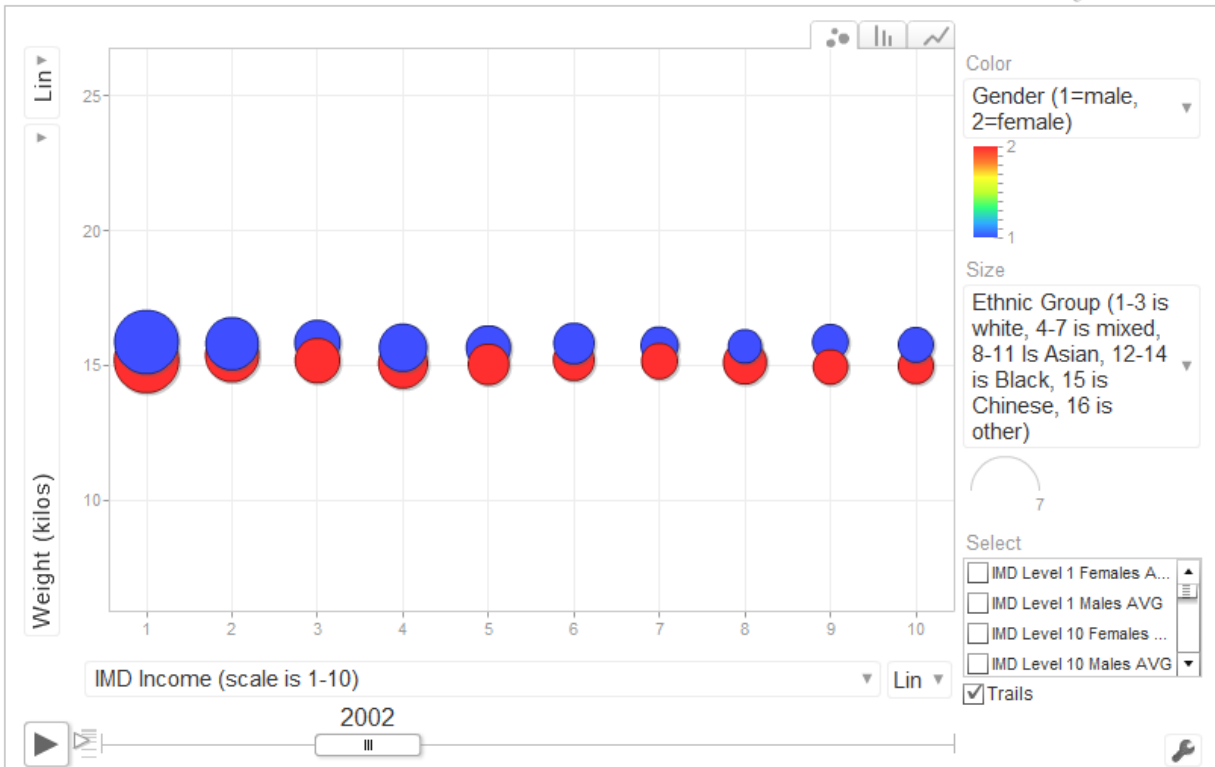


Figure 23. *Income versus 2-year-old weight for babies in the British Millennium Cohort study. By two years of age, differences in weight among classes, and between males and females are no longer present.*

World data—pre-natal care and infant /mother survivability

As with pre-natal care, in most countries of the world, except sub-Saharan Africa and the Indian sub-continent, a large percentage of births are attended by a health care professional (Figure 24). Pre-natal care has been shown to be highly correlated with lower infant mortality rates, and, as we saw in Figure 18, infant mortality rates are low for the non-African countries, and are coming down in the Indian sub-continent. Slightly higher levels of infant mortality in Northern countries may be due to technological levels of intervention for newborns. It may also be that higher levels of Caesarian section in Northern countries are responsible for lower infant mortality rates. On the other hand, it has been argued that Caesarian sections are now too high among Northern countries and detract from the quality of birthing care.

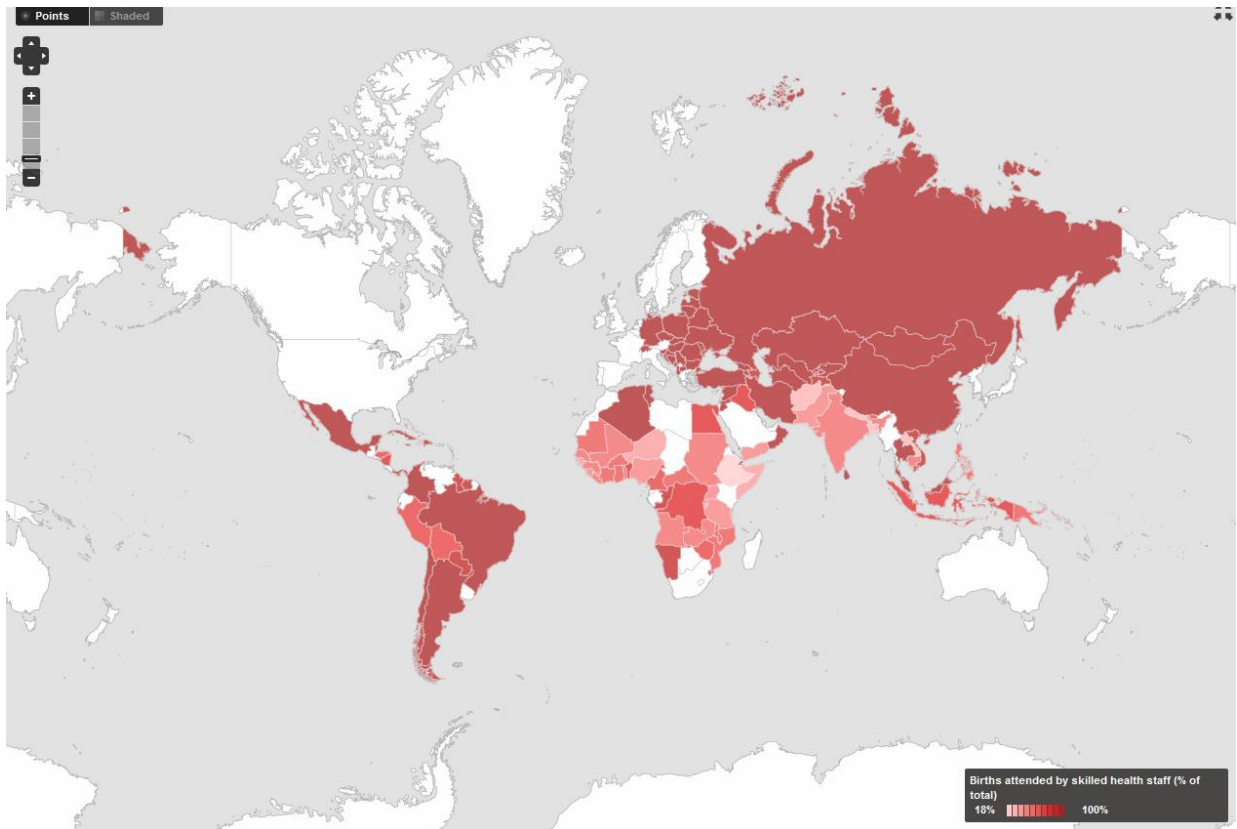


Figure 24. Word levels of births attended by health care professionals. Data are from the World Bank for most developing countries (<http://data.worldbank.org/indicator/SH.STA.BRTC.ZS/countries?display=map>). Countries in white have no data available. For Europe and North America, rates would be very close to 100%. In general, levels are high world-wide but lower in sub-Saharan Africa and the Indian sub-continent.

In the last 20 years, Caesarian sections in European and North American countries have at least doubled (Figure 25). Albeit this increase in Caesarian section has accompanied a slight decrease in infant mortality rates, or success in terms of survivability, the operational question for us is whether this increase in Caesarian interventions has led to increasing satisfaction or well-being regarding family's birth experiences. According to the film *The Business of Being Born* (Epstein, 2007), women may not only be losing a powerfully rewarding unique life experience by resorting to Caesarian sections, in particular voluntary C-sections, but this may be a damaging way to start a newborn's life. The moments immediately after birth, when initial bonding and first breast-feeding take place, are surely disrupted in significant ways by the process of a Caesarian section.

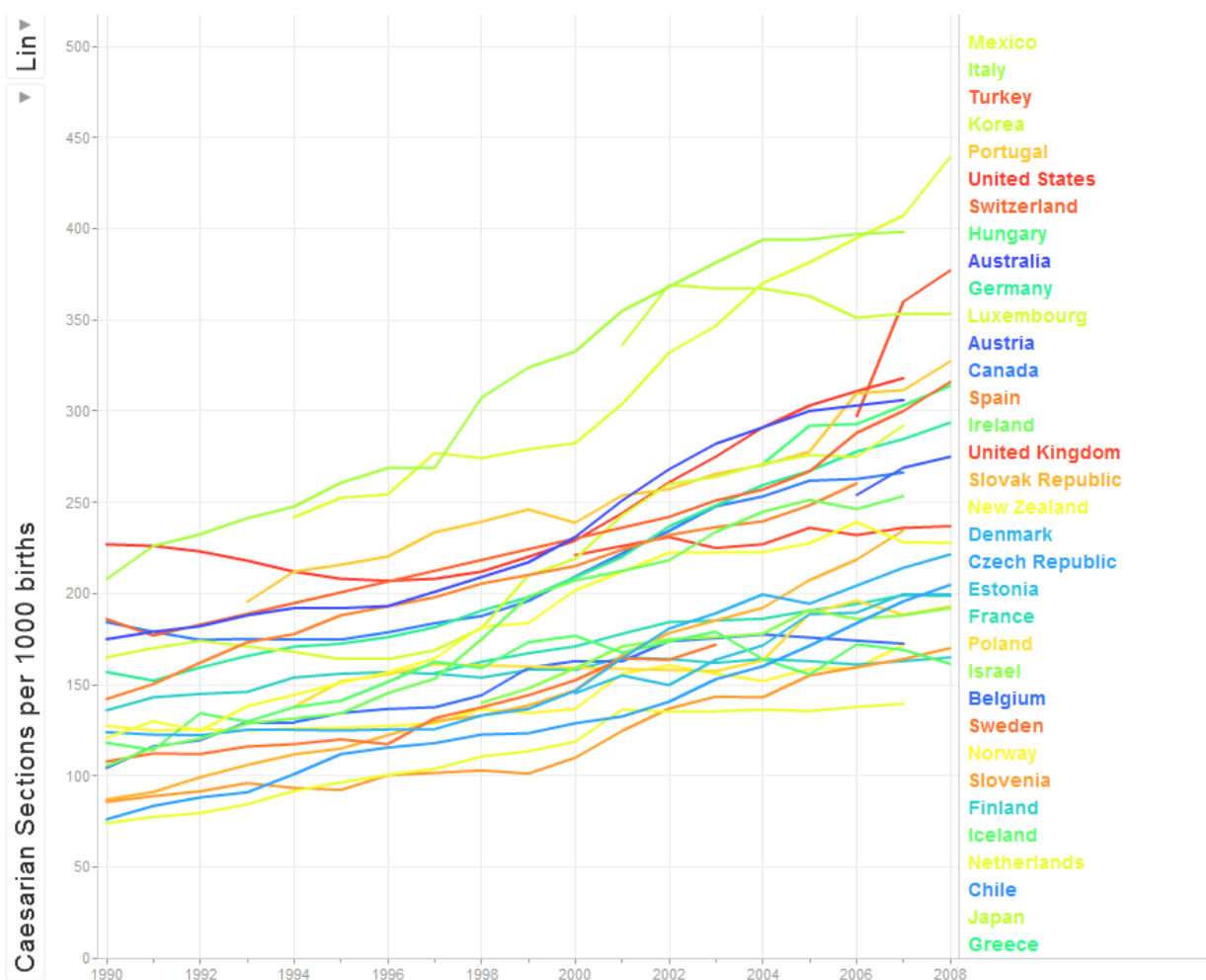


Figure 25. Increase in Caesarian section (number per 1000 births) from the Organisation for Economic Co-operation and Development (OECD, 2010) for so-called developed, mostly Northern countries where access to highly technological allopathic medicine is readily available. For most countries, Caesarian section rates have at least doubled over the last 20 years.

Childbirth experience care tradeoff—conclusion

As with pre-natal care, the experience of childbirth seems to require balance on the scale of power use to maximize life fulfillment. The experience of Sub-Saharan Africa, where limited access to any birthing care results in high levels of infant mortality must be a very painful one. On the other hand, it would appear that the increasingly high levels of Caesarian sections and relatively un-caring hospital birthing care as seen in Northern countries is detrimental to the family's sense of fulfillment and

satisfaction around the birthing experience. In the case of some European countries, especially the Netherlands, a newer option is appearing to carry the population beyond the constraints of high power use and lower fulfillment during childbirth. The use of midwife care at home births has taken countries like The Netherlands to a lower level of power use (and an accompanying higher level of spiritual satisfaction) without compromising the success of the process as measured by survivability or infant mortality rates.

CHAPTER EIGHT: Data for Infancy and Toddlerhood

During the first two to three years of life, a child's physical, emotional and cognitive development begins. Among higher income families, especially in Northern cultures, much attention is paid to the timing and pace at which the child reaches certain size and behavior milestones. At the same time, parents tend to be very focused on the physical safety of the child, often purchasing items, such as car seats and infant monitors, which are marketed for their security features. Among lower income families, and especially in the South, parents naturally keep their children close by, usually sleeping in the same bed, breast-feeding and being carried and handled frequently. Some practices, especially breast-feeding, are universally recognized as invaluable for the child's long-term well-being, but realization and follow-through are very dependent, or constrained, by the power use level of the family.

Tradeoffs regarding breast-feeding

The benefits of breast-feeding are recognized world-wide, and the practice is almost universally promoted by pre-natal care providers, family physicians, pediatricians and virtually all health care providers. Increasingly, however, the cultural milieu appears to be a prime determinant of whether children are breast-fed, irrespective of public policy or the advice that is provided by health care providers.

Anecdotal evidence—Ibarra, Ecuador

In Ibarra, the sight of mothers breast-feeding their babies is common. Children of all ages are a strong presence in the typical multi-generational home. Large numbers of people, also of all ages, are encountered on sidewalks throughout the city, in parks and plazas, and in the small-stall retail markets where most people purchase their regular provisions, house wares and clothing. In all of these settings, women openly breast-feed their babies with frequency and on-demand from the child. Over the last ten years, breast-feeding practice has changed so that most women now offer the breast from the open top of

their blouse, whereas previously they were more prone to lift the waist of the blouse or cover their chest with a towel or blanket. The practice is assumed to be a normal part of every-day commerce and it is not something that would invite comment, or that would even interrupt a conversation, a business transaction, a meeting, or any other typical interaction among family members or among strangers. Most mothers do it as naturally as they might re-arrange their clothing or the position of their hand-bag.

At the government-run day-care centers, mothers typically stay with their pre-school aged kids during the half-day class times. Some mothers might help prepare food, others might work with the teachers on a given activity, and many just sit in provided chairs and chat, or help watch the children. Many mothers bring their younger infants or toddlers and most commonly hold them throughout the class-time, breast-feeding the babies frequently, whenever the babies seem to want to feed.

Mothers are reluctant or uncomfortable to talk about breast-feeding, not because it is anything embarrassing or unusual, but because it is just not something they give much thought to. Occasionally, a mother who could not breast-feed might be seen working with bottles and formulas. They find this to be an unwonted bother and expense. As one mother said,

No sé...yo siempre doy el seno a mis bebés. No creo que sea gran cosa. Para mí, es un orgullo poder alimentar a mis niños y espero siempre tener leche suficiente. Una vez me dijeron que la formula pueda que sea buena para aumentar la comida de mi bebe. Pero no creo en eso. Mi mama también siempre nos daba el seno y aquí estamos bien no más. [I don't know...I've always breast-fed my babies. I don't think it's such a grand event. For me, it's a privilege to be able to feed my children and I hope I will always have sufficient milk. One time they told me that formula might be good for augmenting the nutrition for my baby. But I don't think so. My mother always gave us breast-milk and here we are just fine.]

Some mothers actively wean their babies, usually between one and two years of age. But more commonly, mothers reported that the baby seemed ready to stop breast-feeding, or that “the time had come” and they just stopped.

Anecdotal evidence—Prescott, Arizona

In Prescott, most families are “nuclear” with just parents (or one parent) and their immediate children living at home. This means that most families only have infants and toddlers present for a few short years

of the home life-span. This is considered alternately a special time, or a time of great sacrifice as parents are constantly stressed and relatively unhappy. Public places where large numbers of people can be encountered are virtually non-existent, with the exception of special events like the “white-tent” fairs in the central square, or a performance at the coliseum or fairgrounds. If these events have a child-oriented component, then large numbers of children are present. In fact most of the people who attend such events are families with small to school-age children, and other families or age-groupings, such as young singles, childless couples, or elderly individuals consider such events intolerable due to the large number of children present. At the shopping mall and in the town center, children are a very minor portion of the typical public that is present. Breast-feeding, if it ever occurs in public, has not been witnessed by me, or anyone else I know. The few times that I have seen women breast-feed at home or in a more private place, it has always been a notable event, one that the woman prepared for, commented on, and performed while covering her chest with a towel.

Among the mothers who bring their pre-school age children to the government-run day-care center, many have smaller infants or toddlers with them or at home. Very occasionally, one of the mothers stays to help the teacher in the classroom, but most mothers drop their children off and then go to run errands or to work, picking their children up at the end of the half-day classes.

These mothers report that they are always encouraged to breast-feed by their health care providers, starting in pre-natal care and continuing through the infancy period whenever they visit their pediatrician, nutritionist, or any other health care provider. Many of them say that they initiated some breast-feeding in the hospital, but that they knew they would not have time to breast-feed and so they started with formula immediately thereafter.

Many mothers seemed uncomfortable talking about breast-feeding, in part because it is an embarrassing topic, and in part because they know that they “should” breast-feed their children, but they never have. As one mother said,

Everyone always tells me how important it is to breast-feed. But when am I going to breast-feed. I am working or doing chores and errands all day long, from early morning to late at night. I get free formula from the WIC [government nutrition] program so it doesn't cost me anything. And all I have to do when J..... is hungry,

is give him a bottle. Ooh...I can't imagine having to cover myself up and then get out my breast and then sit there while he is sucking away. My family is all disgusted by the thought of it and so I guess I would have to go and do it alone...no, no, no...he is just fine with his bottle.

Two populations of mothers in Prescott rarely use the government-run day-care center and they are more likely to breast-feed their babies. One group is the relatively small number of educational professionals associated with the colleges or schools. Some of these mothers breast-feed their babies, at least while they are on maternity leave, and many of them continue to pump breast-milk that is fed in a bottle after returning to work, often providing their paid day-care providers with chilled or frozen breast-milk to feed the baby. These mothers would not often be comfortable breast-feeding their babies in public. The other group is a “counter-culture” mostly associated with Prescott College, and includes families that create “permaculture” homes with gardens, often raise chickens or other animals, and the mothers may not work at a full-time job outside the home. These families are the most likely to breast-feed their children for a year or more. They may also be comfortable breast-feeding in public, at least among their community of friends and family.

Local population quantitative data: Percentage of breast-fed babies and time of weaning

The comparison of breast-feeding and income levels between the Ibarra and Prescott government-run pre-school populations is striking, and fits with the anecdotal data (Figure 26). In Ibarra, the relatively low-income population (less than \$500 per month) families breast-feed for one to two years, on average. In Prescott, the relatively higher income (over \$1200 per month) families breast-feed for less than two months, on average. In the Prescott area, the Sedona population is an outlier as one of the highest-income centers with an average breast-feeding time of nearly four months. This may be happenstance with a few long-term breast-feeding mothers skewing the average for this center. However, the Sedona demographics, with a large number of alternative-style families, many from other parts of the country where breast-feeding might be more acceptable, may be the reason for the unusually long breast-feeding average in Sedona.

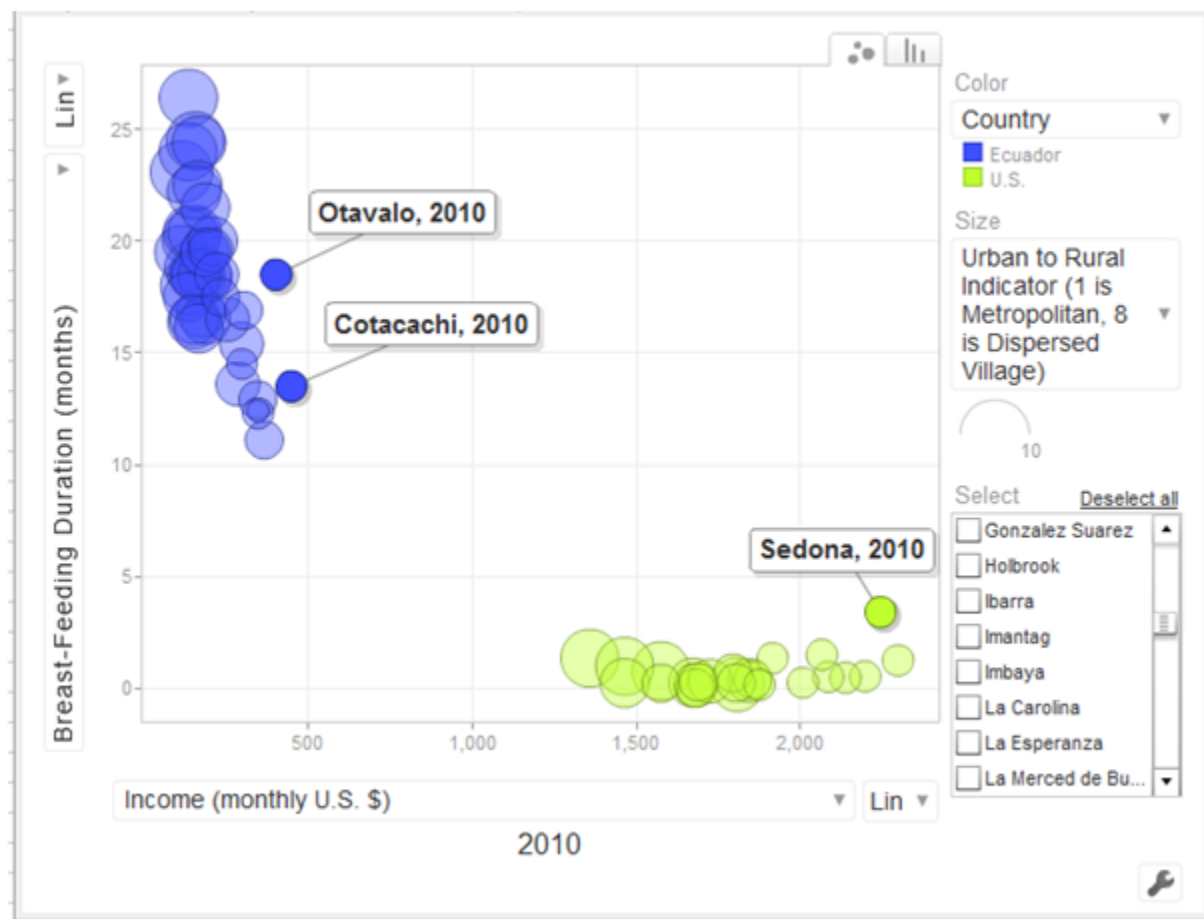


Figure 26. Breast-feeding by income class for Ibarra and Prescott government-run pre-school populations. The relatively low-income Ibarra population shows much longer duration of breast-feeding than the relatively high-income Prescott populations.

Among the different Ibarra pre-school populations, those in higher-income, more urban settings show a trend towards shorter periods of breast-feeding (Figure 27). This is probably due to a higher number of working mothers at these centers, along with many urban mothers who are more influenced by Northern cultural norms and thus less likely to breast-feed for long periods of time. The Otavalo and Cotacachi centers show higher incomes and relatively longer duration of breast-feeding, probably due to the larger number of traditional indigenous families among the population.

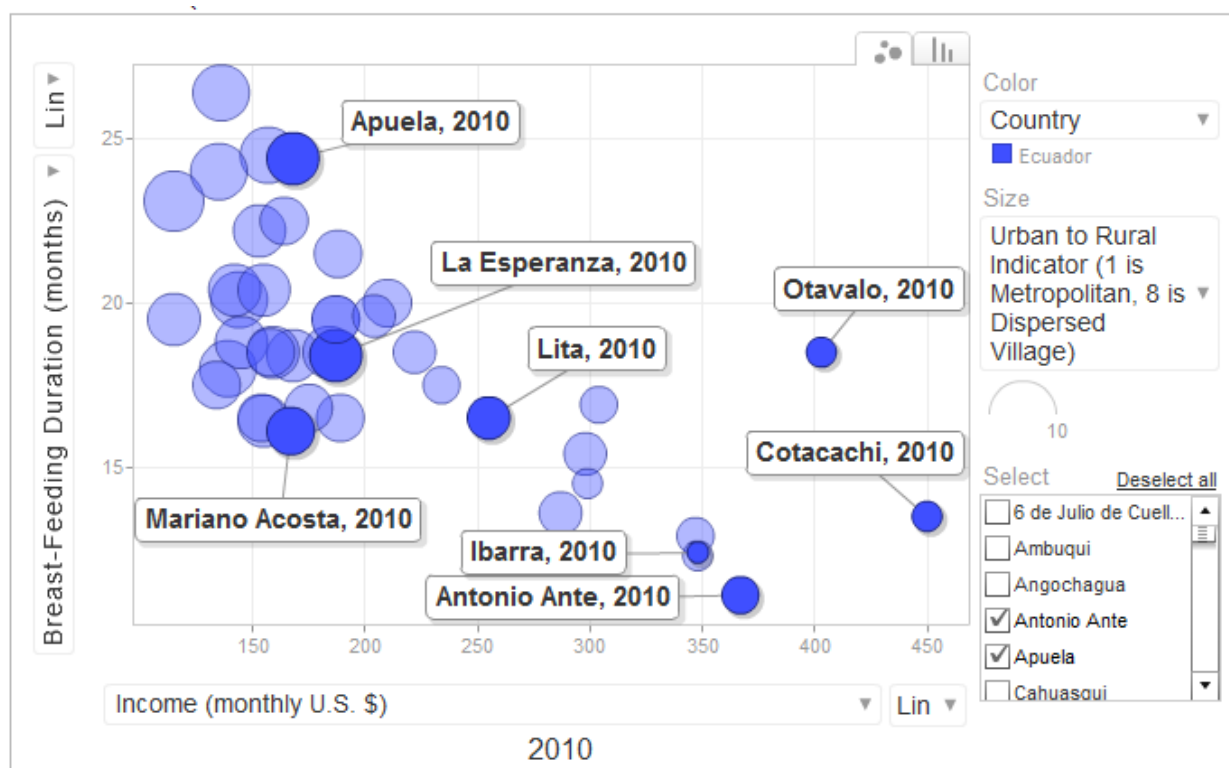


Figure 27. Breast-feeding by income class for Ibarra government-run pre-school populations showing trend towards less duration of breast-feeding in higher-income urban areas.

Among European countries, England has one of the lowest rates of breast-feeding. For the Millennium Cohort Study (MHS) families, nearly 70% initiated breast-feeding, even if this meant just one time with the baby on the mother's breast. However, the rates of continued breast-feeding are low, although they are on the rise relative to the 1970 British cohort study, which showed a low of only 21% of mothers that continued breast-feeding beyond one month (Dezateux et al., 2005). This was down from 60% in the 1946 cohort and 44% in the 1958 cohort whereas in the 2000 cohort, the one-month continuation rate was back up to 50%. This recent rise in longer-duration breast-feeding may be the result of public policy changes promoting awareness of breast-feeding benefits (DH, 1998, 1999, 2004). But more likely it is due to higher levels of immigrant population presence (mostly South Asian), and their greater likelihood to continue breast-feeding in an accepting cultural milieu, much like what is seen in Ibarra, Ecuador (Byrd et al., 2006; Gibson-Davis & Brooks-Gunn, 2006).

The higher income populations in the MCS study show a longer period of breast-feeding (Figure 28). The very short average duration of breast-feeding among low-income families probably reflects the high number of single working mothers in those populations (Dezateux et al., 2005). The rise in breast-feeding duration at lower mid-range incomes (IMD Income scale 4-5) may reflect the presence of immigrant families, especially those of South Asian descent, among these income groups (Dezateux et al., 2005). The longest duration breast-feeding averages, among the very high income and predominantly rural populations, may reflect educated, non-working, and even noble-class families where stay-at-home mothers have private spaces and little limitations on their time for breast-feeding.

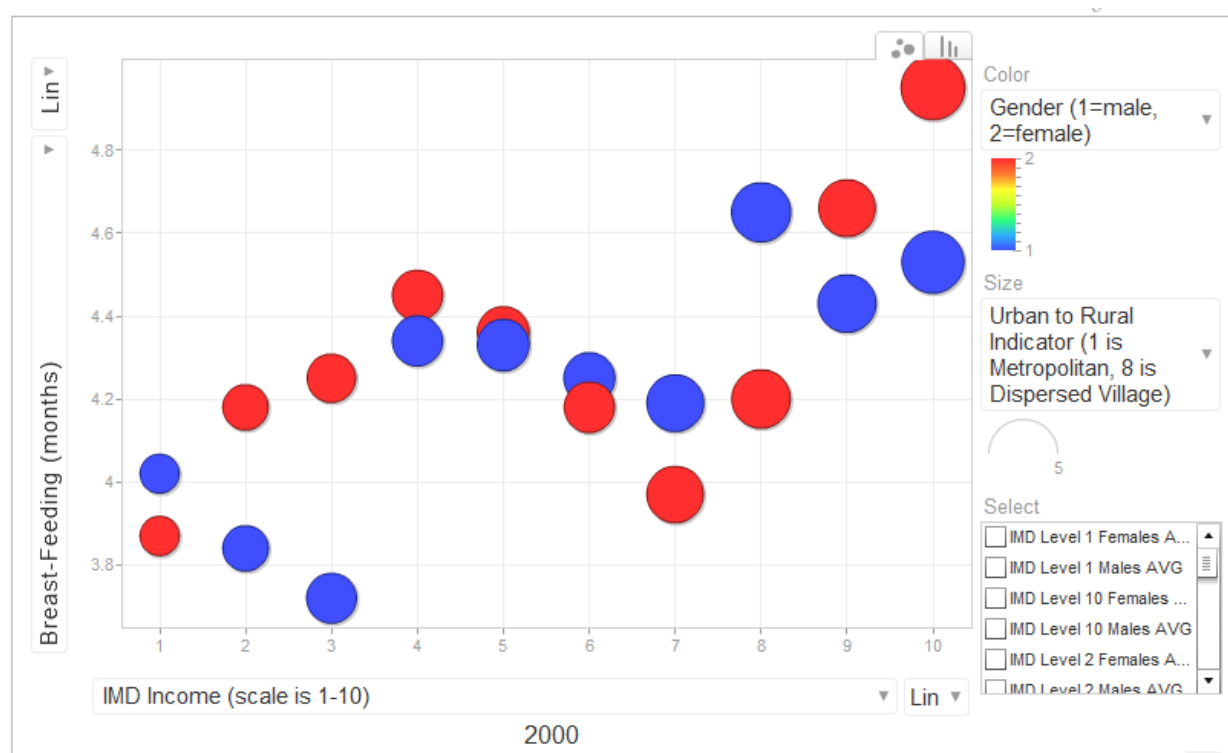


Figure 28. Breast-feeding by income class for British Millennium Cohort Study. Very high income families show the longest duration of breast-feeding, probably representing extremely wealthy, educated noble-class women who have time and private spaces for breast-feeding. The rise in duration among low-middle income families (IMD Income Scale 4-5) may be due to high numbers of immigrant families in those groups.

World data—breast-feeding in the developing world

Both the United Nations Children’s Fund (UNICEF) and the World Health Organization (WHO) collect data on the percentage of mothers that initiate breast-feeding and the duration of breast-feeding. Data from industrialized Northern countries are scarcer than from the developing world. This is probably because many studies show very high levels of initiation of breast-feeding in most industrialized countries, and this is the key focus of developmental projects run by UNICEF and WHO. However, duration of breast-feeding is often very low among Northern countries.

The world-wide situation shows that the duration of breast-feeding beyond six months is not very carefully correlated with the level of economic “development” in that country (Figure 29). In fact, the highest levels of breast-feeding duration among the Southern lower-income (and lower energy cycling) countries are spread geographically throughout the world in countries and cultures recognized for their community and cultural support of breast-feeding. These countries include the Andean countries (Bolivia, Peru, Ecuador), some sub-Saharan African countries and central Asia (China, Mongolia).

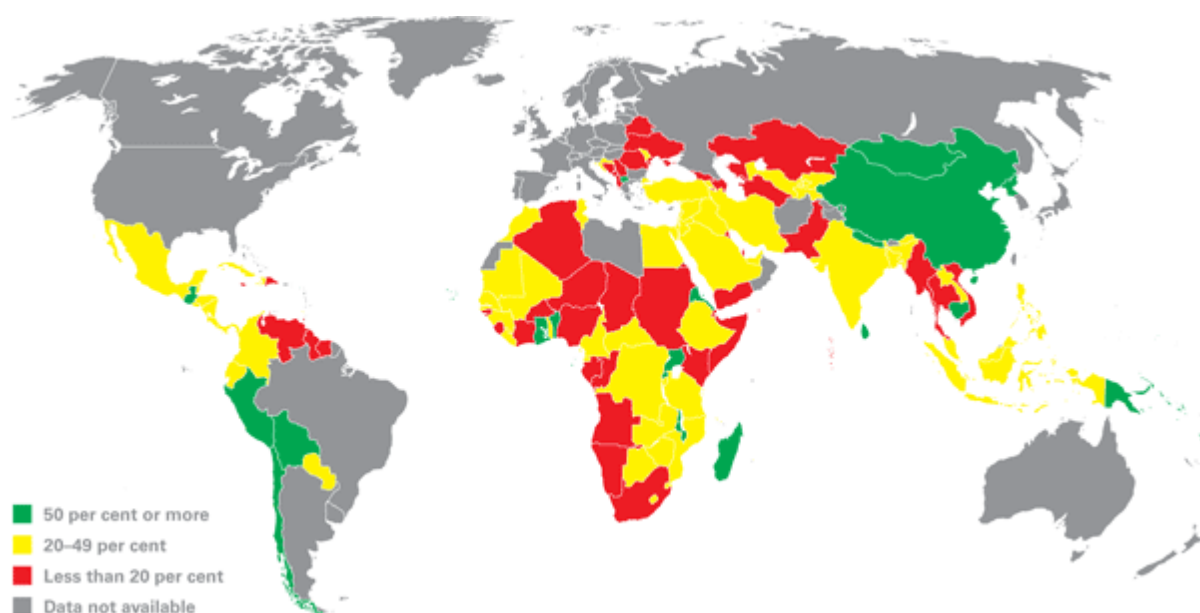


Figure 29 . Breast-feeding duration world-wide. Colors indicate percentage of children less than six months old who are exclusively breast-fed. China, Mongolia, and the Andean countries show the highest level of families where children are regularly breast-fed. (UNICEF, Unite for Children, http://www.unicef.org/nutrition/index_24824.html)

Among Northern countries, the levels of long-duration breast-feeding also vary tremendously. England and the United States rank among the shortest duration of breast-feeding, while the Scandinavian countries and central Soviet republics have much longer average duration. It is hard to discern an exact trend with geography or income regarding the duration of breast-feeding. More data are still needed to understand the situation in Northern countries, and to provide quality policy advice in all parts of the world among all different kinds of institutions and entities.

Breast-feeding tradeoffs—conclusion

Formula feeding from a bottle is a higher-energy-cycling, economically-based solution to providing nutrition for an infant, from birth leading into the toddler years. It often removes the mother from direct contact with the baby and provides a very different experience for both. Breast-feeding, on the other hand, is a metabolic-level, spiritually-oriented activity that puts mother and baby into direct contact, often for several hours each day, around the simple act of providing food for the baby. In addition, the nutritional and general health advantages of breast-feeding have long been recognized.

As family situation tends towards higher power use, breast-feeding becomes less common. However, compared to the nearly inflexible correlation between family power use and the level of pre-natal and birth interventions leading to Caesarian sections, breast-feeding practice appears to be more flexible. Given the widespread recognition, among cultures and populations of all backgrounds and power use, that breast-feeding is beneficial; given the relatively small energetic differences between breast-and bottle-feeding; and given a somewhat reduced societal infrastructure and expectation for bottle-feeding among high-power-use populations (at least relative to styles of birth care), it appears that it is easier for higher power use families to sometimes “revert” to spiritual-level breast-feeding. This reversion is seen among high power use professional class women in the United States, and among noble class, stay-at-home mothers in England, although in both cases breast-feeding remains a very private and hidden practice that merits and elicits societal comments. Often these mothers move to a higher-level energy use, pump-based provisioning of mother’s milk that removes the spiritual-level, metabolic activity of direct suckling,

although it is still referred to as “breast-feeding.” The other reversion to breast-feeding among relatively high power use classes occurs in “alternative” lifestyle communities where direct breast-feeding is considered an acceptable part of a more “organic” or permaculture approach to organizing the home. In these cases, breast-feeding becomes a fully acceptable part of the family and societal milieu and mothers carry it out publicly and often well past the first year of the baby’s life.

The high power use families’ “reversions” to metabolic-level breast-feeding activity serve to highlight the strong correlation between family energy use cycling and a tendency towards economically-based technological solutions to child-raising needs, in this case the provisioning of a milk diet during the first years of a baby’s life. The very ineffectiveness of widespread publicity campaigns regarding the benefits of breast-feeding along with nearly universal health-care provider advice to practice breast-feeding (even to high-energy-use families) suggests that breast-feeding is not a conscious choice, but part of the larger picture regarding a family’s position in the power use space. The accompanying cultural milieu that permits or denies the practice of breast-feeding can be seen as part of the society or population’s larger energy cycling regime. In Ecuador, a generally slower-paced energy use regime allows for mothers to spend more time with their babies, and it is assumed that breast-feeding will be a natural part of that time. However, within the high-paced energy cycling lifestyle that is *de rigor* in the U.S., breast-feeding is seen, despite every attempt to negate the image, as troublesome, time-consuming, and even revolting.

Around the world, partial evidence suggests that some cultures—most notably Northern Europe and Central Asian cultures—have overcome the constraint on high power use and metabolic-rate breast-feeding. However, further analysis and more in-depth data are needed to ascertain how long, and with what style, of breast-feeding is really being practiced in those regions. If they really do represent a path off the correlation curve between high energy use and low levels of breast-feeding, acceptable to an entire population, then they may be a model for re-acquiring balance regarding this aspect of child-raising. In addition, more attention should be paid to the meaning of world-wide breast-feeding statistics and the campaigns, conducted or inflicted by the part of Northern culture “development” projects, to promote the

practice among economically poor countries. On the one hand, it may be that the marketing of baby formula is interfering with widespread acceptance and practice of breast-feeding among low power use populations. However, the percentages of breast-feeding mothers are often based on whether the baby is given exclusively breast milk, which seems to be a commonly-held goal for economic development organizations. This may be an extreme response to previous attempts by formula-makers to open a market in developing nations. Breast-feeding mothers often notice, at a younger age, that the baby is ready to accept other kinds of food, and so this may be the only extent to which mothers deviate from pure breast-feeding. This must be distinguished from the use of formula to replace mother's milk. On the other hand, if mothers are using formula because they are so nutrition-deprived themselves that breast milk is insufficient, then this practice cannot be solved by simply promoting breast-milk, without treating the larger food security issues.

Tradeoffs regarding direct parental contact and carrying of the baby

The child psychological literature gives a lot of attention to the kinds of cognitive and emotional input a baby receives, and the resultant outcomes in terms of the age at which certain behavioral milestones are reached (Robokos, 2008). However, often overlooked is the level of satisfaction, fulfillment, or simply calm, that is reached during the early years of a baby's life. Direct parental contact, as well as attention from many close adults and older children, may be important in providing a quality atmosphere and higher levels of fulfillment during the early years of a child's life (Small, 2001).

Anecdotal evidence—Ibarra, Ecuador

Typically, a baby in Ibarra will spend the first two years of its life in almost constant presence, and often direct contact, with its parents, or some other close family member—be it grandparents, aunts or uncles, older siblings or cousins. The baby will surely sleep in the same bed as its parents, and this practice may be continued well into the school-age years. The practice of “co-sleeping” along with nearly

universal breast-feeding during early months, results in few complaints of sleep deprivation or high levels of stress among parents with a new baby.

The baby will be taken almost everywhere that its parents go, to the extent that this is possible. Bringing along the baby is part of the family's daily routine, not something that requires much special preparation. Babies are brought along while performing daily chores and errands, provisioning for the household, medical and other visits, social visits and often work, especially when the workplace is a small business or some other informal environment. When the baby is transported, it will be held or carried in its mothers arms. Strollers, car-seats, carrying bassinets and other devices to hold the baby are rare, but becoming more common. Since the mother has nutrition at the ready in her breast, a diaper and some wipes might be the only additional items that parents carry with the baby.

Books, toys, and other special products geared towards attracting the attention of small babies are also relatively rare. Some babies might have a plastic rattle or some other object that is especially for them. However, most commonly babies are entertained with whatever objects or activities might be at-hand. When the baby is fussy and appears to need some sort of diversion, any adult or older child might momentarily distract it. Or, some nearby household object, like a piece of fruit, some keys, a basket, a cell phone or TV remote, or any other nearby item might be proffered as a temporary item of interest to the baby.

In a regular flow, without ever designating a particular care-giver, adults and older children who are present will alternately look after and entertain the baby. Rarely does this flow require any kind of conscious decision-making, negotiation or monetary compensation. This even includes regular providing of care for mothers who work, especially if the mother works nearby and can visit the baby during her workday. As one mother said,

“Sí, mi cuñada me da viendo el bebe mientras voy al trabajo. Tanto como le ayudé con su último hijo, también me considera...ella está todo el día en la casa y allí tiene algo para hacer. Muchas veces, mi hijo duerme como yo entro al trabajo en la tarde, y cuando regreso ya está durmiendo. Entonces, no creo que le haga mucha tarea estar viendo el muchacho. [Yes, my sister-in-law watches the baby while I go to work. Just like I helped her with her last son, she takes me into consideration...she is at home all day long and this gives her something to do.

Often my son sleeps and since I start work in the afternoon, when I return he's already sleeping. So I don't think the little guy gives her much trouble.]

Day-care is a relatively rare and new concept in Ibarra. However, as immigration of nuclear families into the city, leaving extended family behind in the rural areas, along with emulation of Northern culture, becomes more common, day-care for small babies and toddlers is now sometimes arranged. Most often this is with more distant family members or friends, but some early child care centers receive smaller children and provide regular care, either government-based or fee-based. The style of care in these centers was not a focus for the current project and so was not investigated with anecdotal evidence.

Infants and toddlers are rarely fussy. The notion of a "colicky" baby is non-existent and when they do cry or protest, almost any nearby adult or older child has a natural instinct for finding a way to distract and calm the baby. No baby is ever left to cry or be distraught for long periods of time. If nothing else, the baby is carried until it is calm again.

Anecdotal evidence—Prescott, Arizona

A baby in Prescott is rarely in direct contact with its mother, father or another adult. The baby will generally sleep in its own crib or bassinette and parents must rise up from their bed, sometimes even walk to another room, to bottle-feed the baby when it cries in the night. This practice is one of the key components of what is assumed to be a high level of sleep deprivation and stress among parents with a new baby.

Taking a baby out of the house requires a large amount of preparation and many materials must be brought along. A diaper bag along with baby formula and toys are carried apart from the baby. The baby itself might have one or two plastic carriers, to seat it in the car or to provide it with a portable sleeping location. While the baby is transported, it is rarely in its parent's arms, and most often is in a car-seat, bassinette or stroller. Some babies are taken along for regular daily chores, household provisioning and other activities. This is most common if the mother is not working. For working mothers, the baby is left with a day-care provider as soon as the mother's maternity leave from work, a

few weeks at most, is over. The presence of babies in the workplace, even if it is a relatively informal workplace like a small business, is considered unacceptable.

Parents devote large amounts of energy searching for, purchasing, and enticing babies with specially designed products such as toys, books and other interactive objects specially made for babies, and often marketed as important for their cognitive development. Babies are discouraged from handling regular household objects or items that might belong to adults.

If other adults or older children are present, the only way they are asked to take charge of the baby is through a formal arrangement, called “baby-sitting” which usually involves monetary compensation. Even if a monetary exchange is not arranged, the assumption is that the parents are indebted and will provide some exchange service or compensation. When leaving the baby with a designated baby-sitter, as when going out with the baby, a wide variety of materials and instructions are provided. Parents carry a great concern that the baby will be fussy or problematic, and may call the baby-sitter, or at least provide a cell phone number, in case the baby is overly upset.

Many babies are considered to be fussy, problematic and even “colicky.” Parents and other adults despair over how to calm a fussy baby and attempt to use multiple combinations of the many objects that are available as a salve. However, some babies are considered inconsolable and are left for large periods of time, even hours, to cry. Carrying and holding a baby for long periods of time is considered burdensome and is rarely done, so babies are not accustomed to being held. Thus, for a crying or distraught baby, the act of carrying and holding it may no longer function to console or comfort the baby.

Local population quantitative data: Activity patterns for parents and babies

Variables that treat direct parent contact, or the amount of time the infant or toddler is carried or is by the parents’ side are not usually gathered, and this is true for the Ibarra and Prescott pre-school programs, as well as the British MCS study. However, inference can be made from some quantitative information about how parents spend time with their children.

In Prescott and Ibarra, parents answered questions about their favorite activities and how often they are carried out. These data were quantified as an estimation of the awake hours per day spent in close contact with the child (Figure 30). These conversions must be considered estimates at best, but they do seem to provide some insights about the tradeoff between economic status of the family and the time they spend in “spiritual” or metabolic-rate activities with their children. A significant gap is seen between the number of hours that relatively low-income Ibarra families spend in direct contact with their children (from 2.5-7 hours per day on average) compared to the relatively high-income Prescott families (from 2.5 hours down to less than half an hour per day on average). The outlying populations are interesting. In Ecuador, the higher-income Otavalo and Cotacachi populations spend less time with their children, perhaps due to the availability of paid help or extended family-members and a larger household. In Prescott, the Sedona population, with perhaps a higher percentage of alternative-lifestyle families, spend more time in direct contact with the children.

These data do not include time spent sleeping with the child. In Ecuador, parents almost universally sleep in the same bed with their child until at least two years of age, and usually until school-age and beyond. In the U.S., parents rarely regularly sleep with their child, and the practice is considered so unusual that it has a special name, “co-sleeping” under which it is promoted to alternative-style and counter-culture parenting populations (McKenna, 2007). If the time spent sleeping with the child were to be included, then the difference between the Ecuador and U.S. populations becomes even more extreme.

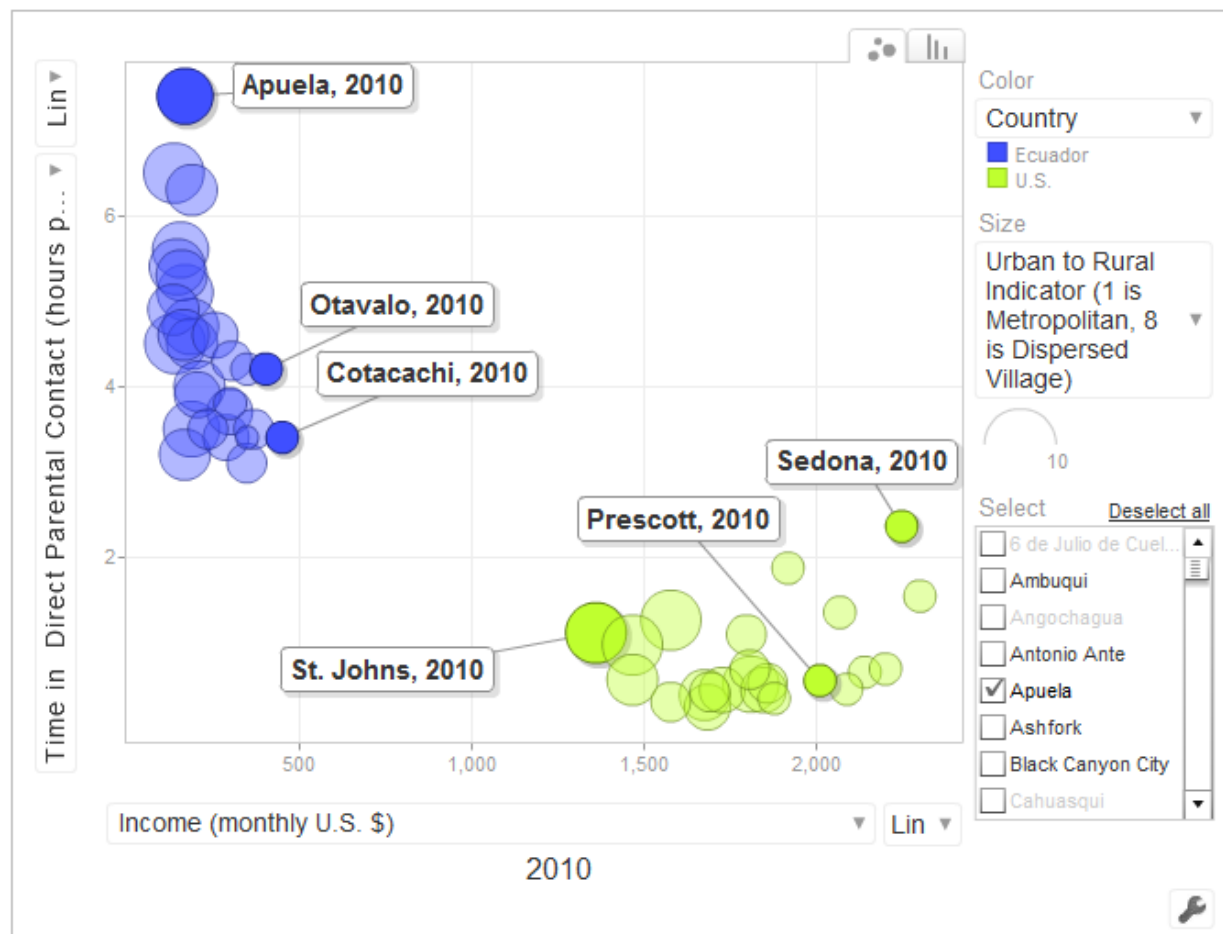


Figure 30. Income versus time that parents spend in direct contact with child (derived variable based on report of time spent in various activities) for Ibarra and Prescott government-run pre-school populations. Higher income families in Prescott spend far less time doing direct-contact activities with their children.

In the MCS study, little data were gathered about actual direct contact time with infants and babies. However, good quantitative information about the kinds of activities that 2-year old children were engaged in was obtained. The only activity that showed a significant trend with income (representing family energy-cycling) was the amount of time parents spent reading to the child, which increased with higher incomes. Whereas child development initiatives frequently encourage more parental time reading to children, this is not a direct-parental contact activity, like carrying, holding or sleeping with the child. When reading to a child, the book becomes the point of contact and, at age two, could even be considered a distancing factor, since 2-year-old children are not always willing to be engaged in a book. What is not reported is whether parents are holding or carrying the child while reading to them.

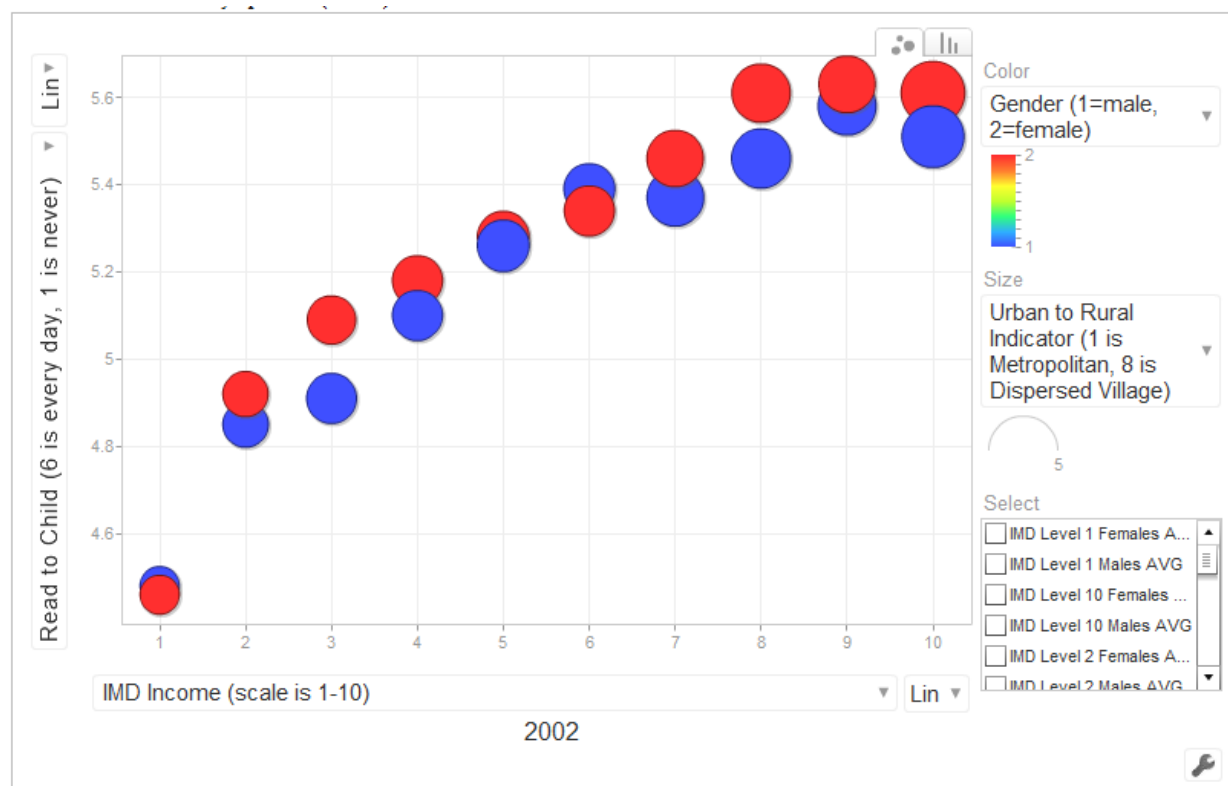


Figure 31. Income versus frequency that parents read to child for MCS populations. Higher income families spend more time reading to child, but this is not considered direct parental contact at two years of age.

Television-watching is considered to be one of the most distancing activities and an interesting pattern is observed here. At two years of age, lower income families report slightly longer hours of television-watching (up to 3 hours per day) compared to higher income families (which report as low as 1 hour per day) (Figure 32). But what is not reported, again, is whether parents are holding or carrying child while watching television. Lower income parents may spend more time themselves watching television, perhaps holding and carrying the child while doing this, and the study did not try to separate out alone versus parental-accompanied time watching television. Interestingly, by five years of age, the situation is reversed and now higher income families report that their children spend longer hours watching television than lower income families (Figure 33). At this age, it is more likely that television-watching is a solitary activity with little parent accompaniment.

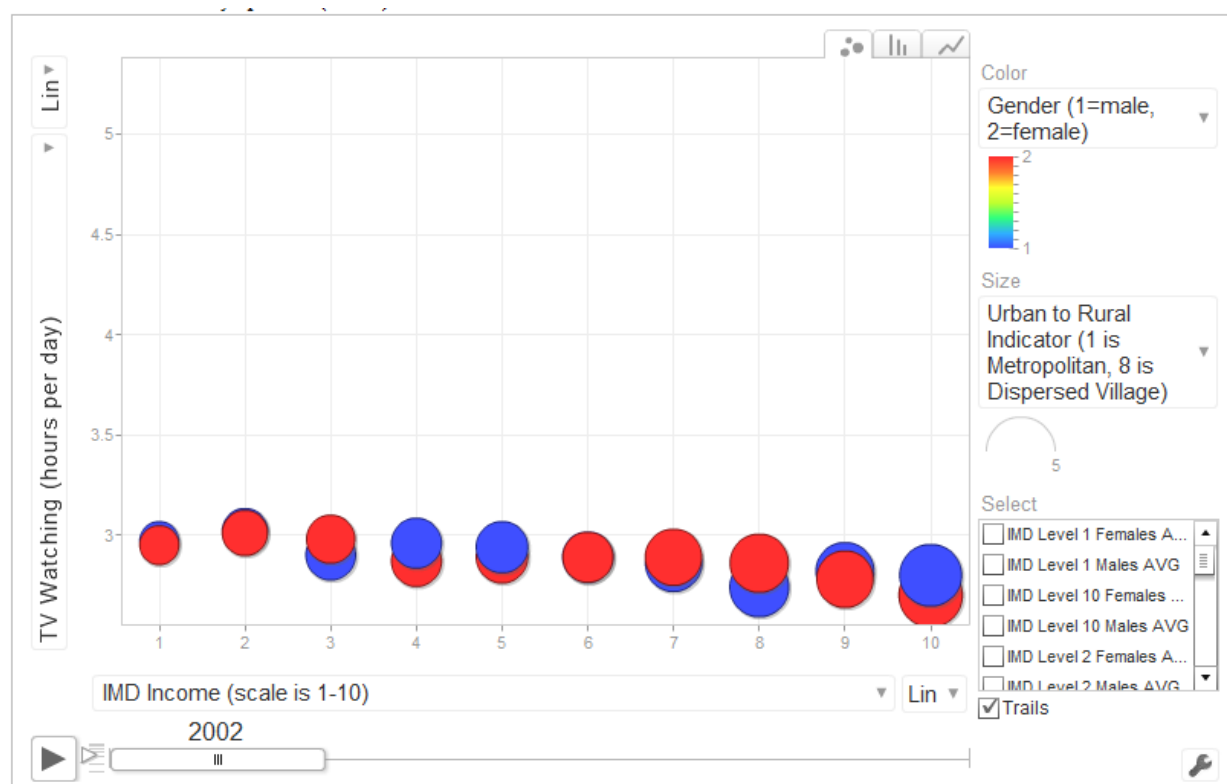


Figure 32. Income versus television-watching time for MCS populations. At two years of age, higher income families children spend slightly less time watching television than lower income families. Not reported is how much of this time is spent together with the parent.

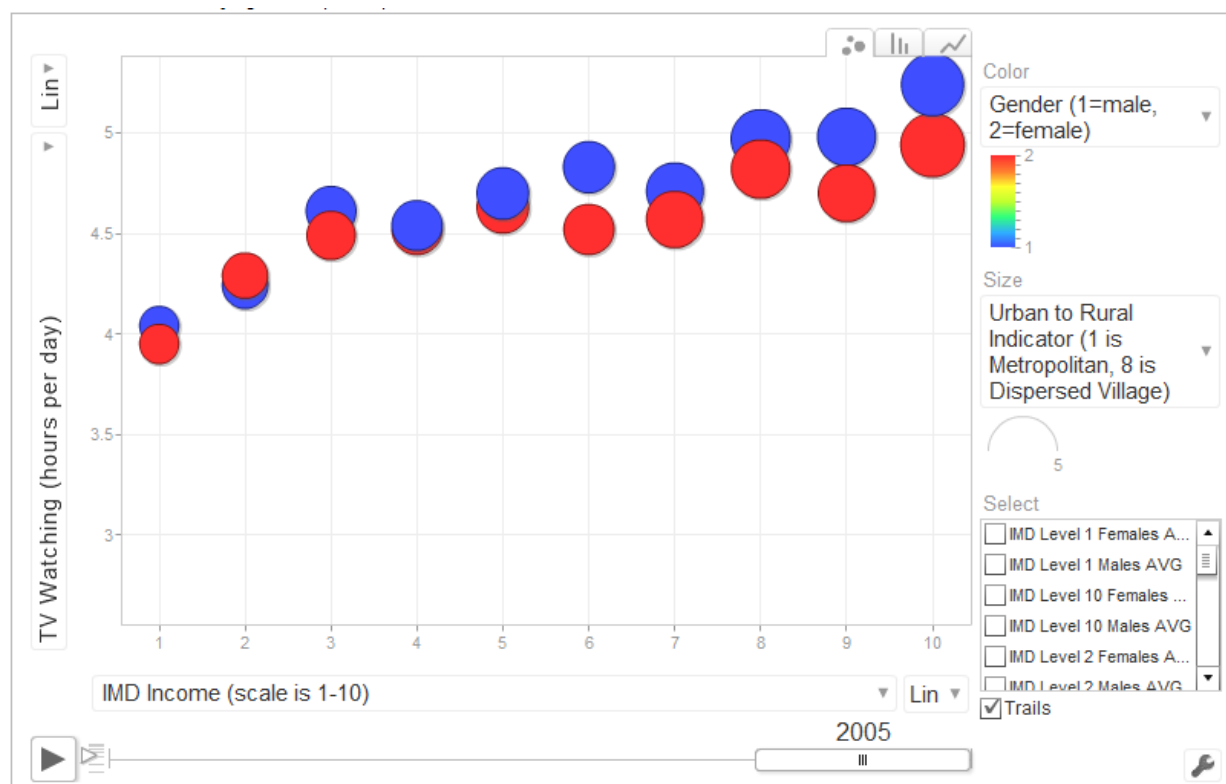


Figure 33. Income versus television-watching time for MCS populations. At five years of age, higher income families children spend more time watching television than lower income families. Not reported is how much of this time is spent together with the parent

One of the few interview questions from the MCS study that directly asked about time spent together was regarding parents teaching songs, poems and rhymes to their children (Figure 34). Here, no significant trend with income is seen, but at all income levels, the time spent with girls is much higher than with boys. The same is true for time that the child spends drawing or doing at home (Figure 35). Among other activities that one might expect to be more boy-oriented, such as sports activities, no difference is seen among girls and boys.

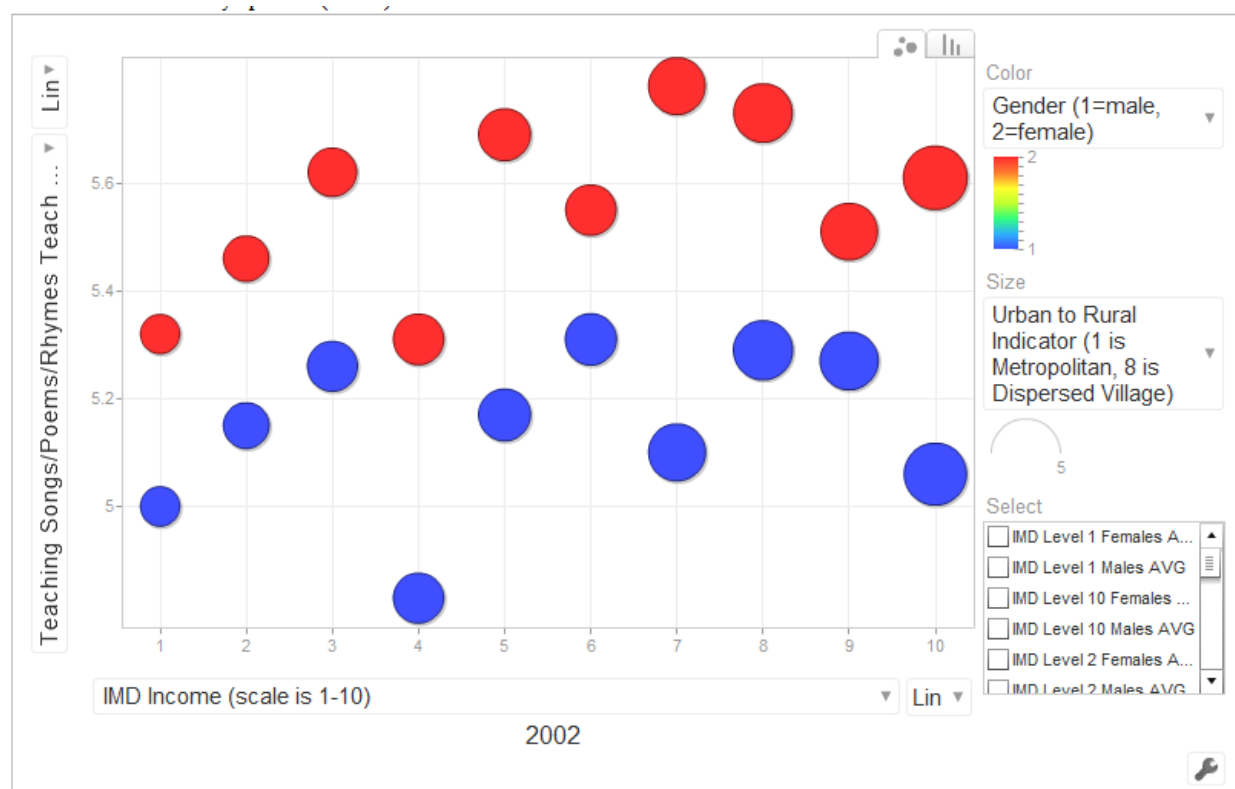


Figure 34. Income versus teaching songs and poems to children for MCS populations. No significant trend is seen with income, but time spent with girls is higher than time spent with boys.

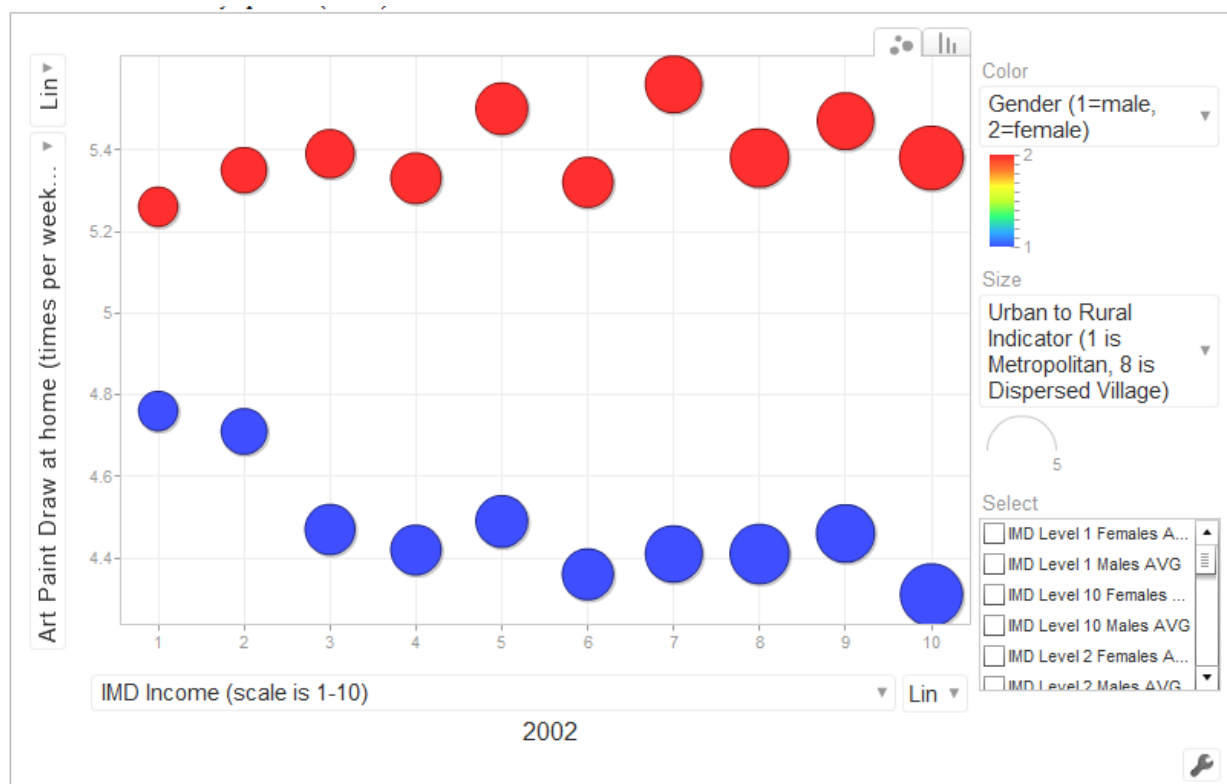


Figure 35. Income versus time spent doing artwork for MCS populations. No significant trend is seen with income, but time spent with girls is higher than time spent with boys.

Anecdotally, one of the key differences among Ibarra and Prescott populations was how many extended families and other adults are present at home. For the MCS population, the number of individuals in the household, mostly representing the presence of extended family members, is significantly especially for the very low income families (Figure 36). This may provide more opportunities for children to spend time in direct contact with adults and older children, and these populations also tend to include higher numbers of ethnic and immigrant families, which like the Ecuador population are likely to maintain cultural values from their home countries.

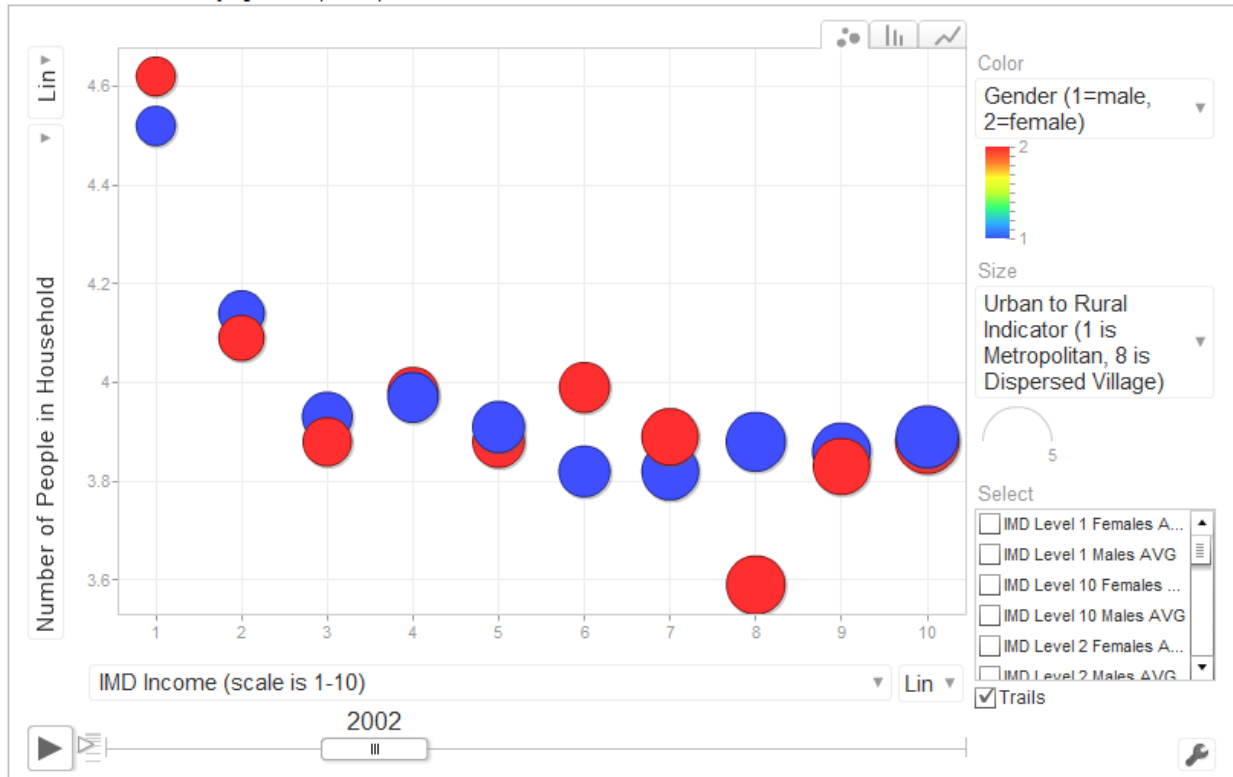


Figure 36. Income versus number of individuals in the household for MCS populations. Lower income populations have significantly larger households.

The MCS study is revealing for how it approaches the question of the way children spend time, perhaps revealing the researchers bias, or in this case the entire social milieu for the large, inter-disciplinary academic and government team that is involved in undertaking a massive longitudinal study. Aside from the few variables presented here, the key focus regarding parent-child time during the early years is how childcare is provisioned outside the family, “For the children born around the turn of the millennium pre-school care and education became a near universal experience” (Roberts et al., 2010). An unspoken assumption is that the effect of professional childcare and educational services is equally or more important than the kind of care and nurturing that the child receives at home. And inevitably, childcare and education becomes more of an economically-based, high-energy input into child-raising when compared with metabolically-driven, spiritually-based family and home care. So, the largest set of data from the MCS study look at how parents pay for daycare, where they obtain it, and the quality of the

centers where it is provided (Roberts, et al., 2010). Interestingly, in final assessment, the smaller centers that most emulate a home environment, with high staff-child ratios, older and younger children combined, and local affiliations, are found to provide higher quality care. The highest-energy input into quality centers is the professionalism and educational level of the staff, again suggesting that they might be most capable of understanding how to replace the needed parental contact that children lose while at an outside daycare provider.

Direct parental contact tradeoffs—conclusion

Lower income parents are more likely to spend long periods of time each day in direct contact with their children. This contact is a regular part of daily activities, and parents carry their children while they work, do household chores, or during walking or public transport. Once a certain level of income is reached, at least in North American and European countries, parents tend to purchase high-power-use objects, like strollers, car-seats and bassinets, to substitute for holding the baby or toddler in direct contact. Although these objects are supposedly purchased as convenience items that should make the parents' daily life more fulfilling, parents report the opposite result. The higher-income, Northern-style parents feel more encumbered by their children, and believe that interacting with them is at times burdensome. The lower-income, Southern-style parents accept that carrying their children is a regular part of their daily activities, and not something they would normally feel bothered or encumbered by. When the time spent directly sleeping with the baby is factored in, the difference between higher and lower income approaches is even more drastic. And whereas so-called "co-sleeping" can be seen as an interruption or distraction for higher-income families that involves some sort of sacrifice, lower income families that regularly sleep with their young children report far less stress and no concern about loss of sleep due to the presence of babies and young children in the home.

Among higher-income families, those who adopt a counter-culture approach to parenting sometimes arrive at similar levels of parental contact, often with a minimal use of technological and high-power-use items such as strollers and bassinets to hold the baby. An alternative market for items such

as baby-slings and pouches, as well as the promotion of co-sleeping has become popular among these populations. However, they represent marginal numbers of parents compared to the mainstream, high-power-use parents who rely heavily on purchased objects and outside care during the infant and toddler years.

CHAPTER NINE: Data for Early Childhood

During the pre-school phase in the North, parents and society focus intently on whether the child has reached a certain level of cognitive ability, which is measured by the first of many decades-worth of standardized tests. At the same time, independence is crucial and parents often treat the child with an expectation that they will understand, rationalize and logic through situations much like an adult. As the so-called “terrible two’s” often stretch into “terrible three’s and four’s,” parents are relieved if the child adapts well to spending all day in a school-like environment. They look for schools where the teachers are well-qualified and a complete pre-school curriculum challenges the child with the start of reading, mathematics, writing and many other learning skills.

In the South, the stubbornness of the toddler and post-toddler years is a source of humor in most families. The child is not expected to show the kind of rationalization, problem-solving or logic that an adult masters. In fact, parents often talk of “*engañando*” or “fooling” the child when they are being particularly resistant or insistent. This is seen more as a way to distract or way-lay the child’s mind so that the object of their focus and frustration is forgotten or replaced. Whereas in recent years parents increasingly take their children to pre-school, mothers often accompany the children in their classroom. Pre-school teachers are expected, by the government, to be trained, and increasingly have university degrees. However, the child’s cognitive level and progress are not routinely measured, and the curriculum is understood more as stimulating daily activity for the children, rather than a means for reaching a standardized set of goals.

Tradeoffs regarding cognitive learning and social abilities

Superficially, the government-run pre-school programs in Ibarra and in Prescott look similar. Federally funded under local government control, with the establishment of neighborhood centers run by qualified teachers who perform daily learning activities with small groups of children are all shared

characteristics. However, the details show significant differences in the goals of the centers, the way parents and families are involved, and the determination of success for the children.

Anecdotal evidence—Ibarra, Ecuador

The government-run pre-school centers in Ibarra are open to any family who would like to bring their children. An initial one-page registration form is filled out, and sometimes very simple tests of the child's ability, such as whether they can recognize or say their letters, are performed. Most centers receive children for half a day and one teacher might be responsible for 20-25 children. However, most mothers stay at the pre-school center with their children throughout the class-time. Some mothers might help organize or carry out an activity and all of the mothers will help distract (*engañar*) a child who might be disruptive, crying or unruly. At the same time, many of the mothers will sit and chat so that the focus is not intently on the children, but sufficient to ensure they are not endangering themselves or others.

Most teachers, through their training, bring materials and activities that promote gross motor skills, fine motor skills, letter and number skills and social interaction. However, they do not have expectations that the children "advance" in these areas, and no standardized measurement or evaluation is ever performed. During a typical school-day, the children might be involved in two or three different activities. The teacher might have a craft project, which the mothers will inevitably help with, thus greatly reducing preparatory time for the teacher, since they can count on mothers cutting out shapes, or any other part of the project that is beyond the capabilities of the children. Most days, the children have outdoor time playing soccer, or a pre-schooler's version of soccer, or some other game. Then the children might look at a book or try writing letters with a pencil. Children, with their mothers, will be engaged in the same activity for at least one hour, and often longer, even two or three hours.

The centers are very simple and might appear austere to Northern parents accustomed to pre-school class-rooms full of teaching materials and toys for the children to play with. However, learning materials and play-things never seem to be in short demand, whether it is balls for more active time, or small manual objects that mothers might have with them for slower time. Learning materials are also very

simple and might consist of a few pieces of paper and crayons, or one booklet that the teacher maintains for each child throughout the year. Because so little material goods can be disrupted or broken or lost, children are generally given full freedom to run and interact in every corner of the classroom and surroundings. A natural rhythm and flow seems to emerge as children move in and out of manual, fine motor, or cognitive, slow-paced and quiet activities into more rambunctious, high-speed and noisier activities. On the one hand, the children are given great freedom to act and do as they please, by Northern standards. Yet on the other hand, children are constantly reminded about respect and constraint, especially when confronting each other, or encountering adults at the center. They are expected to greet each adult, often offering their hand to shake, since this is a regular part of greeting customs in Ecuador. Success, to the extent that it might be measured or evaluated, would be analyzed informally on the basis of how engaged the children were in the day's activities.

Anecdotal evidence—Prescott, Arizona

In Prescott, the government-run pre-schools are part of the federally funded Head Start program and parents must demonstrate low economic resources in order to enroll their children in the school. The intake procedure involves many pages of forms to fill out and a full set of cognitive, health, emotional and ability diagnostics for the children. Most centers receive children for a half-day program, although many are now expanding to include the option of full-day pre-school. Most mothers leave their children at the pre-school and return to pick them up at the designated time. Upon occasion, a mothers will stay for part or all of the school-day, helping out with activities as designated by the teacher; most often these are immigrant mothers of Mexican origin. It is expected that a mother who stays will be helping with activities, and not disturbing other children.

Teachers all have at least an Associate's Degree in the area of early childhood education. They are expected to manage a particular curriculum program, which they might learn on the job, or through their schooling. The curriculum designates exact areas in which the children should be developing—for instance, cognitive, fine motor skills, gross motor skills, emotional expression and more. Landmarks for

development in many areas are identified and observed or evaluated in the children as part of the regular reporting to parents and government authorities. Parent conferences are performed as part of a household visit where the child's home environment is also analyzed. These data are all kept as local files on each family and compiled data are analyzed and released as population-level statistics.

During a typical school-day, multiple activities are organized and carried out according to a calendar created at the end of the previous week. A typical day will include six to eight activities and children rarely spend more than half an hour on any one activity. Recess times outside are short, usually less than 20 minutes, and seen as particularly difficult for teachers since the children encounter more opportunities to endanger themselves or others. Each activity has a particular time-frame and teachers try to keep children on schedule. Meal-times are closely kept and a central kitchen prepares food for the children that meets government standards, which in turn are based on nutritional recommendations that are a combination of political and scientific input.

Teachers are expected to maintain a high level of control over their classroom and the children. One teacher and a paid assistant are responsible for 12-18 children. The classroom itself is full, even crowded, with learning and play materials including easels for painting, water and sand tables, bookshelves, blocks, art materials of all kinds, notebooks, storage bins, hooks and designated chairs, seats and tables for each child. For each day, the teachers have a schedule of activity goals, and part of their daily success is whether those goals are achieved. Small amounts of indoor or outdoor play-time can be scheduled into the activities, but the main emphasis is on learning activities oriented towards achieving cognitive and learning skills, such as recognizing letters and numbers, writing, reading and fine motor skills in general. At the same time, teachers perform almost continuous written anecdotal observation of each child's progress towards reaching cognitive guidelines or landmarks. Formal cognitive and skills evaluations are performed three to four times during the course of the school-year. Success for the program is defined in terms of the overall level of cognitive development that children show through their evaluations, along with how much progress is made for each child over the course of the year.

Local population quantitative data: Measuring cognitive abilities

For the Prescott Head Start population, as well as the British MCS population, large amounts of quantitative data from standardized evaluative testing are available to demonstrate cognitive skills and level. Although decades of critiques have resulted in many attempts to remove so-called “cultural” bias from these evaluations (Garrison, 2009) the entire premise of the testing process is deeply rooted in a Northern and Western approach to the mind, to social structure, and to how children are raised. Learning and cognition may be one of the easiest aspects of overall social-emotional-mental development to measure, and cognition also coincides well with predominant values for Western culture that include rational manipulation of the environment through the creation of technologies based in scientific understanding of the natural world. Whereas these abilities are valuable, they represent a small part of the total human condition, and especially neglect emotional bonding, compassion and empathy, as well as physical abilities and gross motor skills.

The hierarchy of Western academic thought puts science, math and engineering at the top, followed by social “sciences” and humanities with their emphasis on the written word, then works-based artistic abilities followed by movement, dance and theatre towards the bottom, and finally athletics (Robinson, 2006). Within this context, the range of human abilities measured by the slew of standardized testing that begins in pre-school is limited and skewed towards the top end of the hierarchy. Minimal value is placed on the more intuitive, artistic, emotional and physical skills, although their contribution to a fulfilled life may be equally or more important. Given this backdrop, careful consideration must be given as to how much attention should be paid to the results obtained by the standardized tests. Furthermore, the tests are still very biased in the way that they analyze cognitive and learning abilities. Other cultures and systems of learning often arrive at high levels of rationalization and cognition, but through different, experience-based versus logic-based processes.

If we are careful to recognize the very limited value of the standardized tests, it may be instructive to analyze the kinds of tradeoffs regarding cognitive abilities that they might highlight. Virtually all of the standardized direct evaluations performed on 5-year olds, as well as teacher judgments of 7-year old

abilities show that higher income children perform better. This is true for overall evaluation performance (Figure 37), Mathematics (Figure 38), Reading or Language abilities (Figures 39, 40). In almost all of these evaluations, girls, at every economic level, perform better than boys. Of course one way to interpret these results is that higher income children, and girls, are simply better at the skills that the exams portend to evaluate. However, one must ask who is constructing the exams, and with what kind of assumptions about high performance, and important skill abilities, they bring to that process. After many decades of higher school performance by males, the switch to female higher performance has been seen worldwide. Is this because girls are now better students, or better-equipped children, than boys? Or is it because the consciousness-raising campaign for avoidance of academically marginalizing girls and women has now reached fruition, and the exams are structured such that girls perform better. At the same time, a quick glance at any of the evaluative tools, by someone with an in-depth experience with another culture, reveals that the structure and content of the tool would preclude lower income classes and non-Western cultures from comprehending and performing at the same level, at least not without some sort of pre-indoctrination to the process, format and content of the exams.

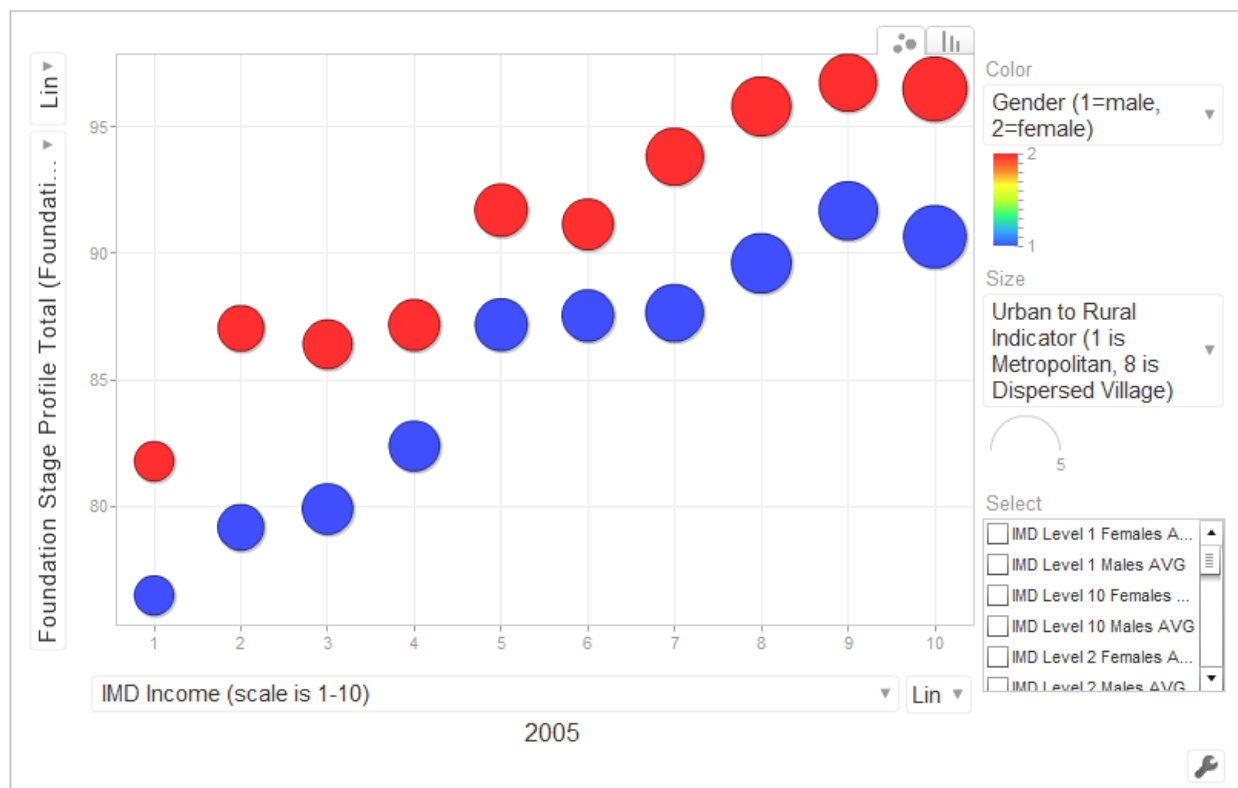


Figure 37. Income versus the sum total performance for 5-year olds on the various Foundation Stage Profile evaluative tools for MCS populations. Higher income populations score better, as do girls within any income class.

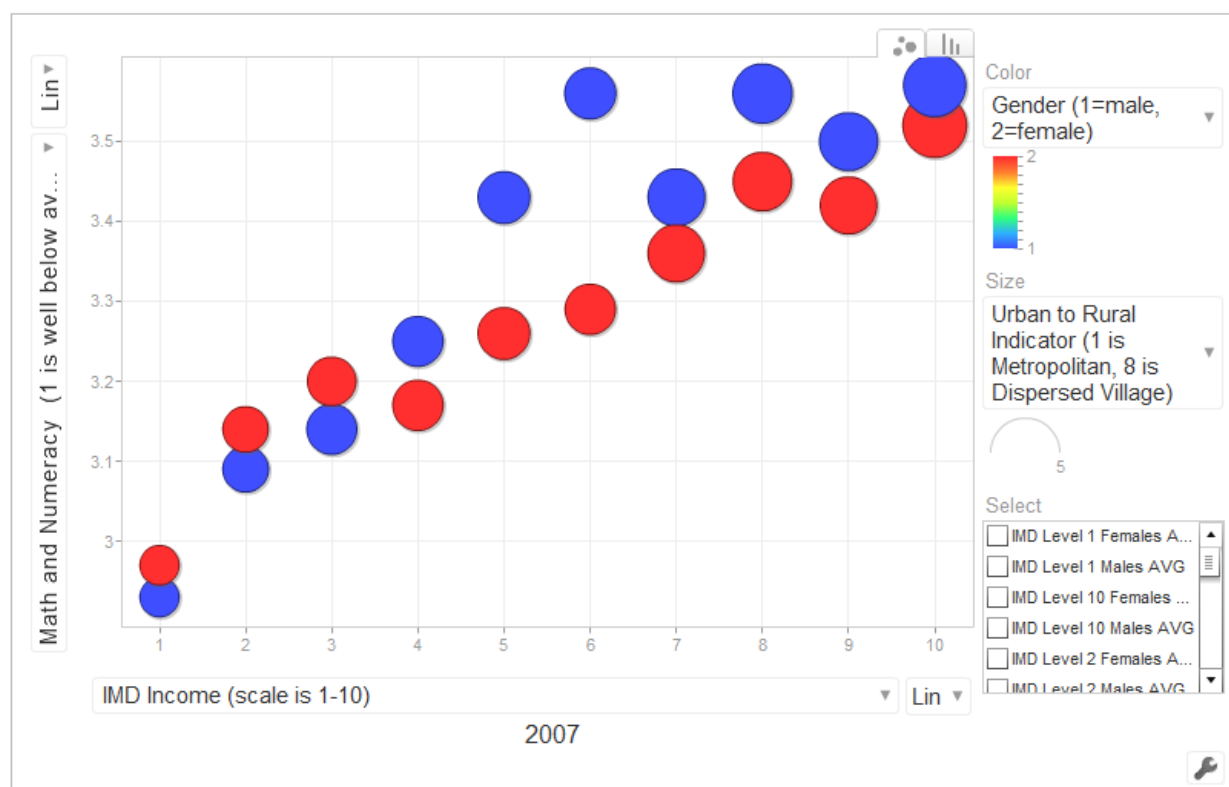


Figure 38. Income versus performance by 5-year olds on Math and Numeracy Evaluative tool for MCS populations. Higher income populations score better, as do girls within any income class.

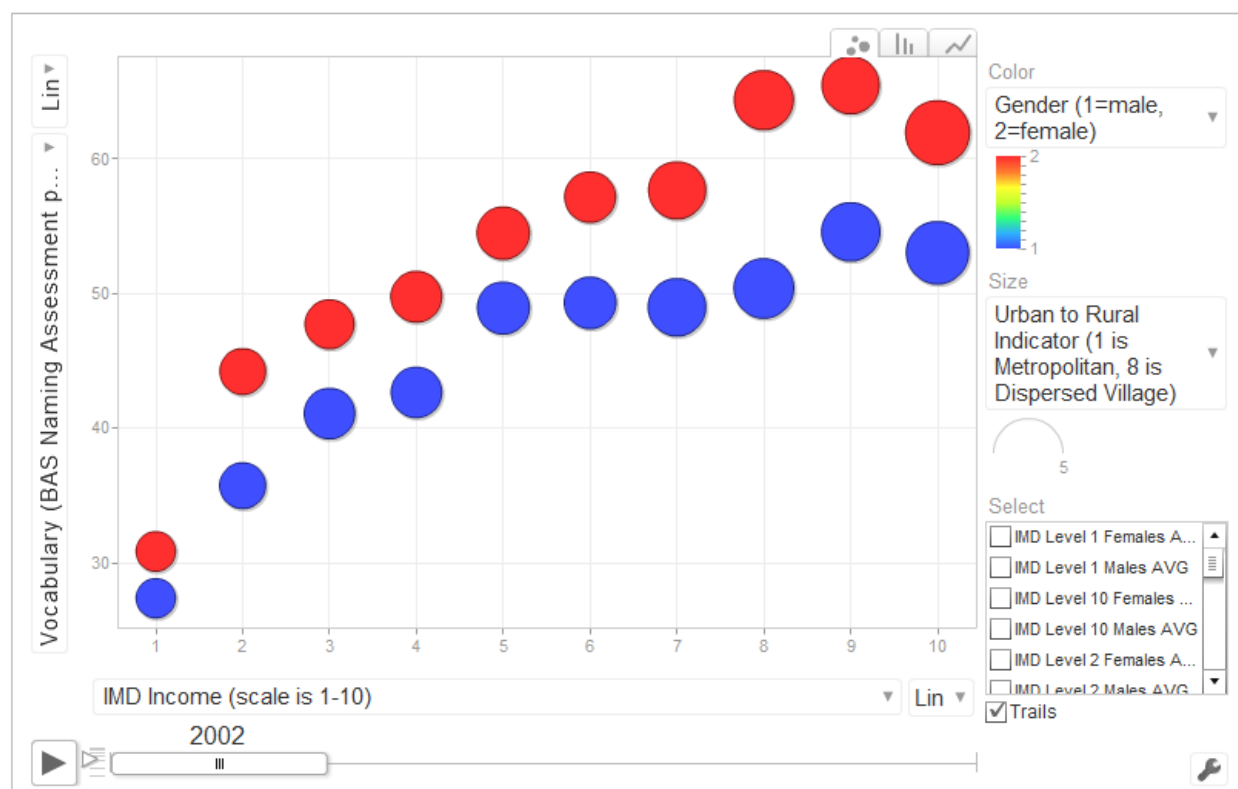


Figure 39. Income versus performance by 2-year olds on BAS Naming Vocabulary evaluative tool for MCS populations. Higher income populations score better, as do girls within any income class.

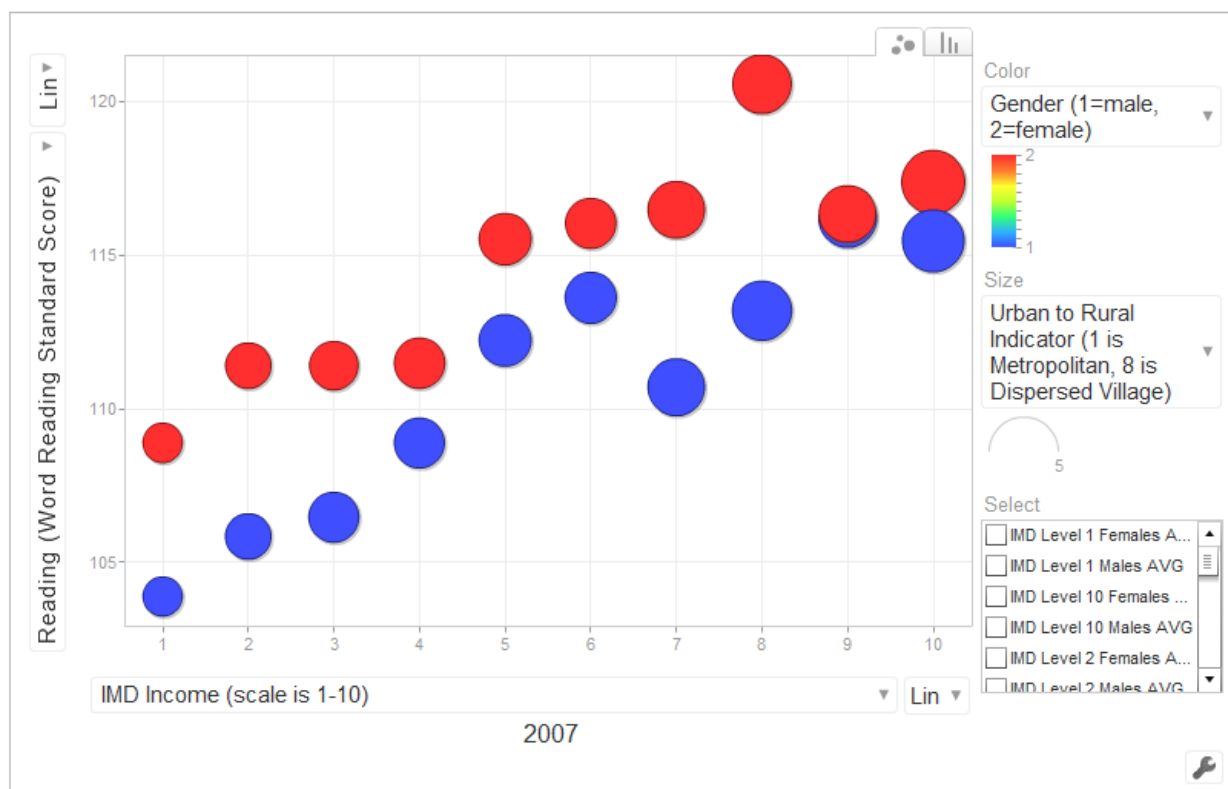


Figure 40. Income versus performance by 7-year olds on Reading evaluative tool for MCS populations. Higher income populations score better, as do girls within any income class.

Interestingly, for one of the few tests that was repeated on more than one sweep for the MC families, Naming Vocabulary shows less discrepancy among income groups in five-year-olds (Figure 41) than in two-year olds. Some studies now suggest that early evaluative differences among socio-economic classes can be later eliminated if similar schooling environments are provided (Eide & Showalter, 1998).

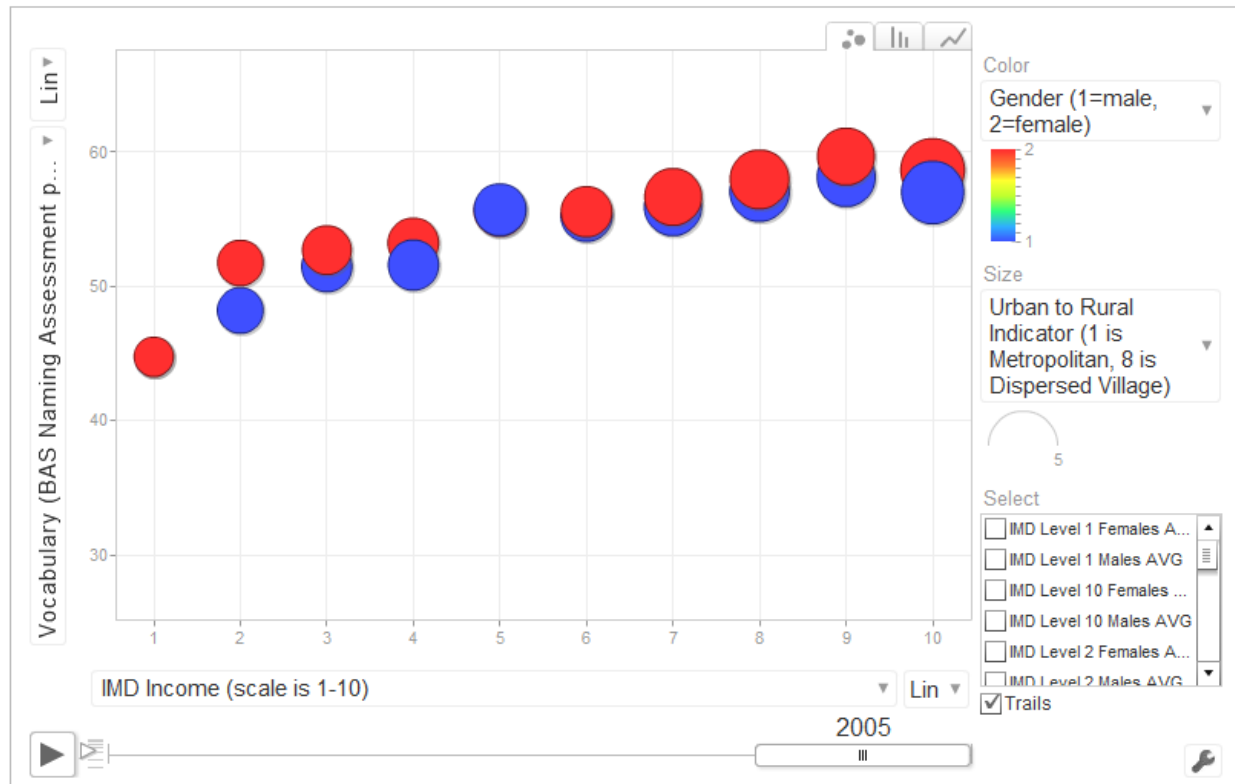


Figure 41. Income versus performance by 5-year olds on BAS Naming Vocabulary evaluative tool for MCS populations. Higher income populations score better, as do girls within any income class.

Similar techniques have been used to design evaluative tools for social, emotional and creative abilities. From the start, one has to ask if these abilities are amenable to evaluating through a standardized testing tool. Nonetheless, tools have been built, especially in response to the critique of cognitive testing that it doesn't fully evaluate the child's abilities. Not surprisingly, given a similar structure to the evaluative tools that are deployed, the results show that girls and higher income children do better on these exams as well (Figures 42, 43). Perhaps this is because they really do have more of the skills that are being tested for. But equally likely is that their overall higher performance on social, emotional and creative testing instruments is due to the inherent bias in the construct, process and administration of the tool.

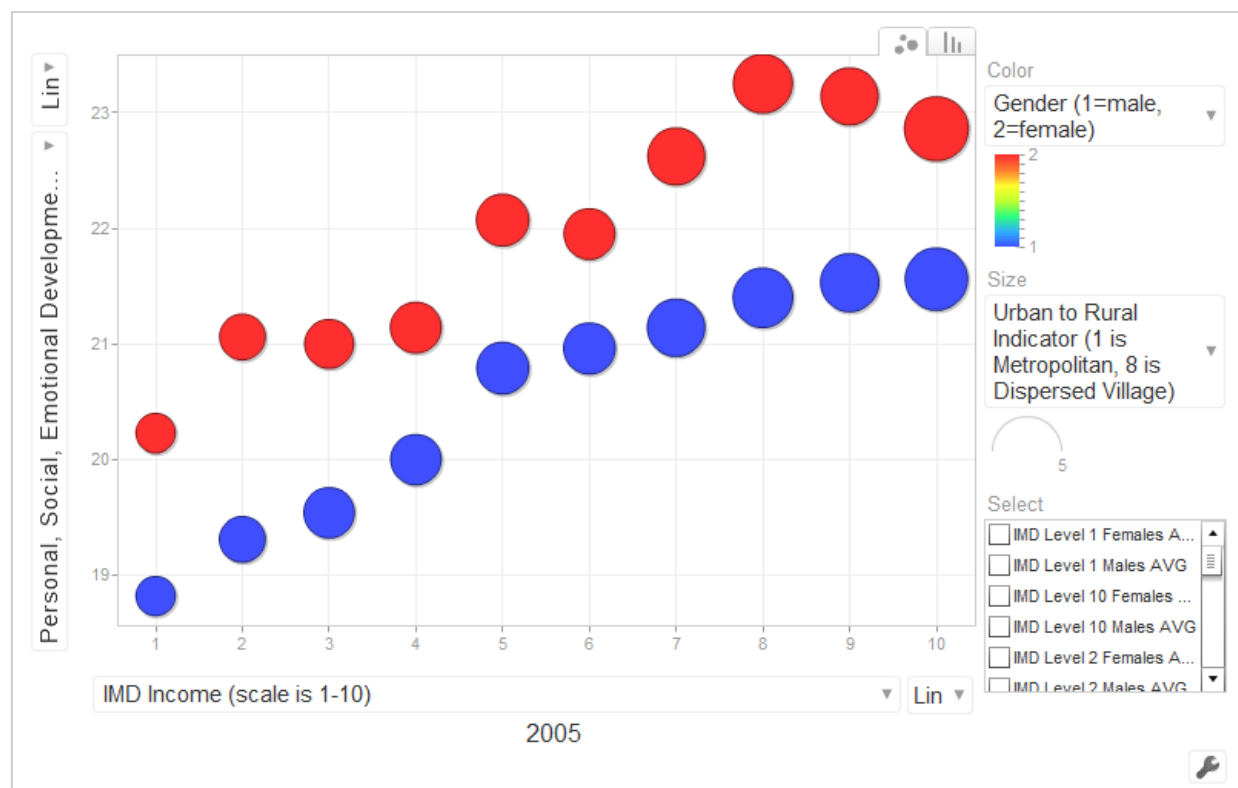


Figure 42. Income versus performance by 5-year olds on Personal, Social, Emotional Development evaluative tool for MCS populations. Higher income populations score better, as do girls within any income class.

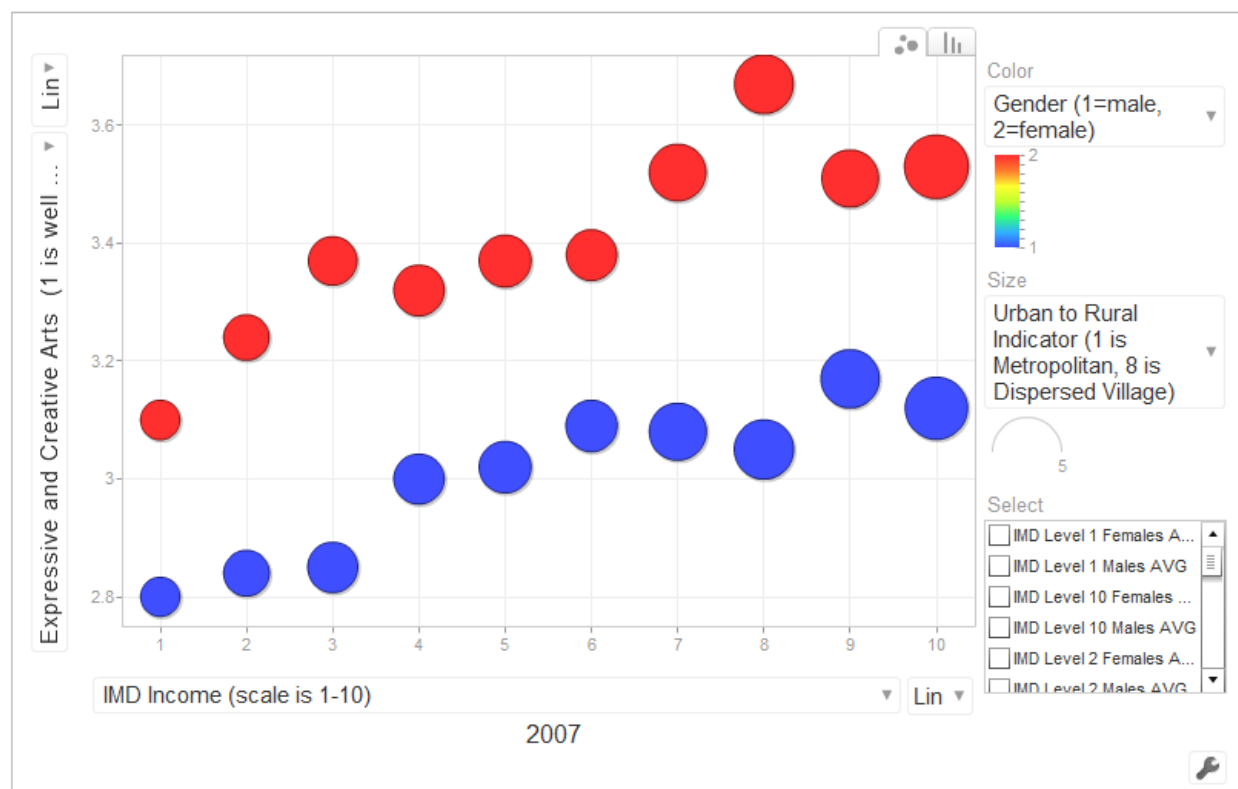


Figure 43. Income versus performance by 7-year olds on Expressive and Creative Arts evaluative tool for MCS populations. Higher income populations score better, as do girls within any income class.

For the few cases where evaluations of home-based, and especially parent participation activities are included in the data, the MCS populations now show better performance by lower income families. In lower income families, children see their relatives more often (Figure 44), presumably developing social skills that might not be available to higher income family's children. In gross motor activities, like sports and exercise, the situation is a little more complex. Whereas higher income family's children spend more time doing sports activities on their own (Figure 45), we see no income effect on how often children spend doing sports and exercise activities with their parents (Figure 46). Interestingly, at nearly ever income level, girls spend more time playing sports alone, where boys have much higher times spent playing sports with their parents. This may reflect the bias of parents towards encouraging their male children into sports more than their female children. This contrasts with time spent doing art and drawing

at home (Figure 47) where income also has little effect, but now girls are emphasized over boys at every income level.

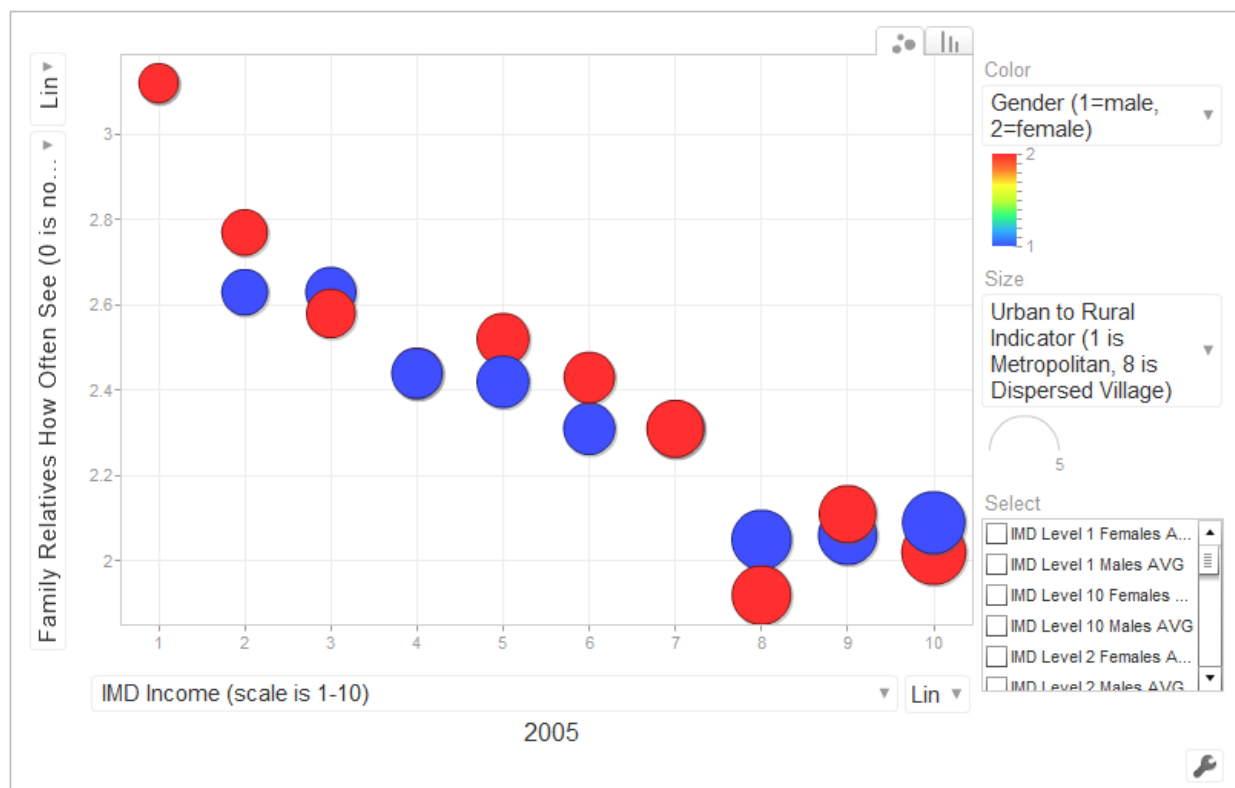


Figure 44. Income versus how often 5-year olds in the MCS populations see their extended family. Lower income families see their families more often.

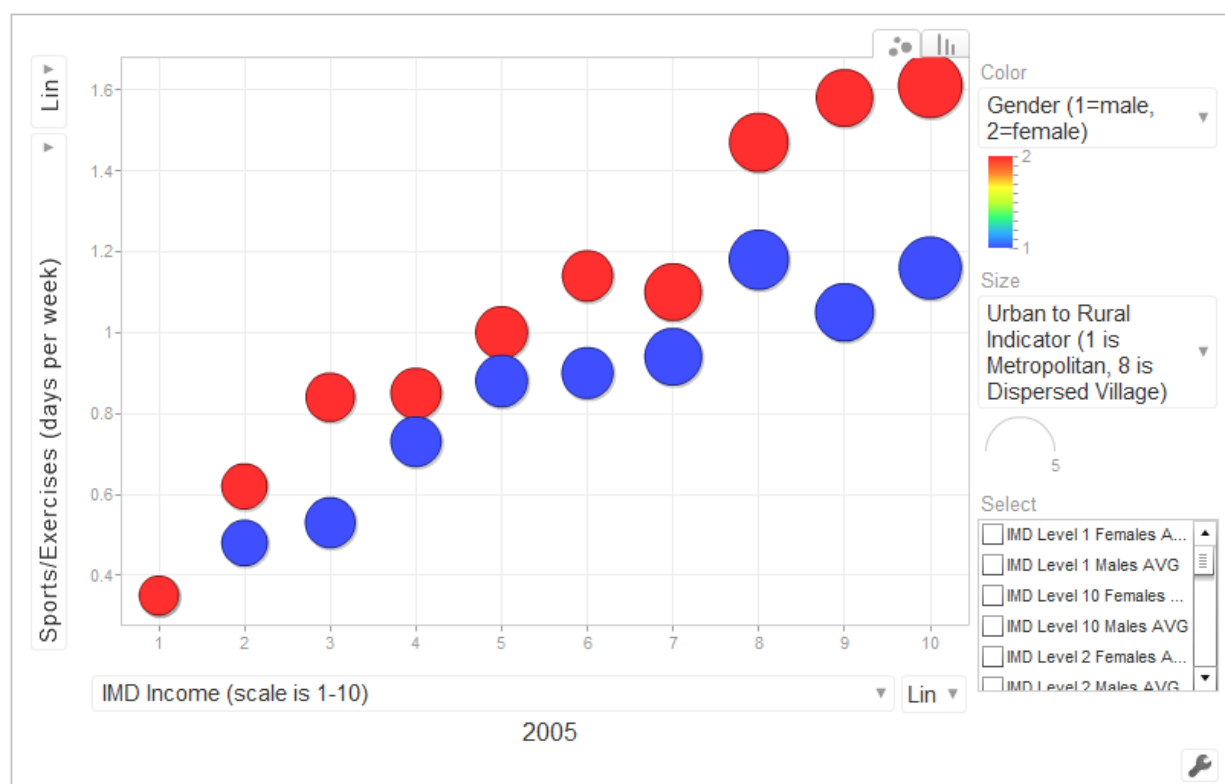


Figure 45. Income versus how often 5 -year olds in the MCS populations play sports. Higher income families' children spend more time playing sports.

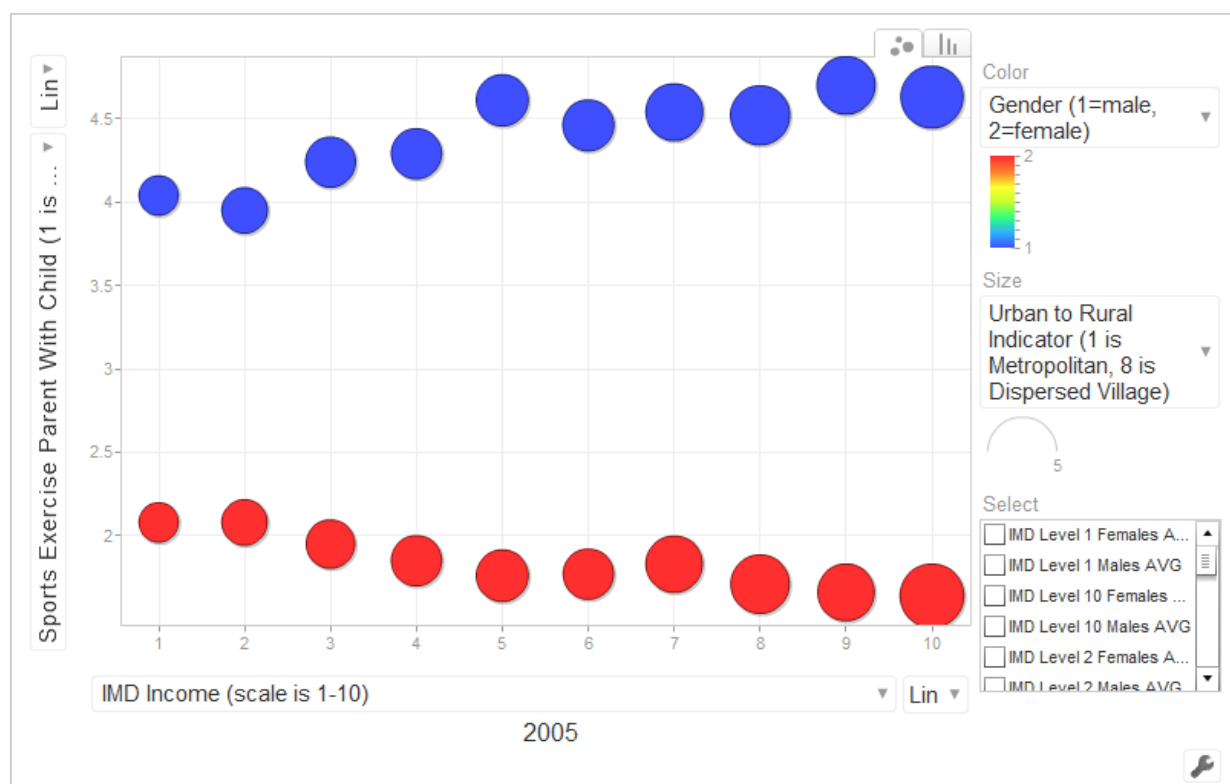


Figure 46. Income versus how often 5 -year olds in the MCS populations play sports or exercise together with their parents. Income has little effect, but more time is spent with boys than girls at all income levels.

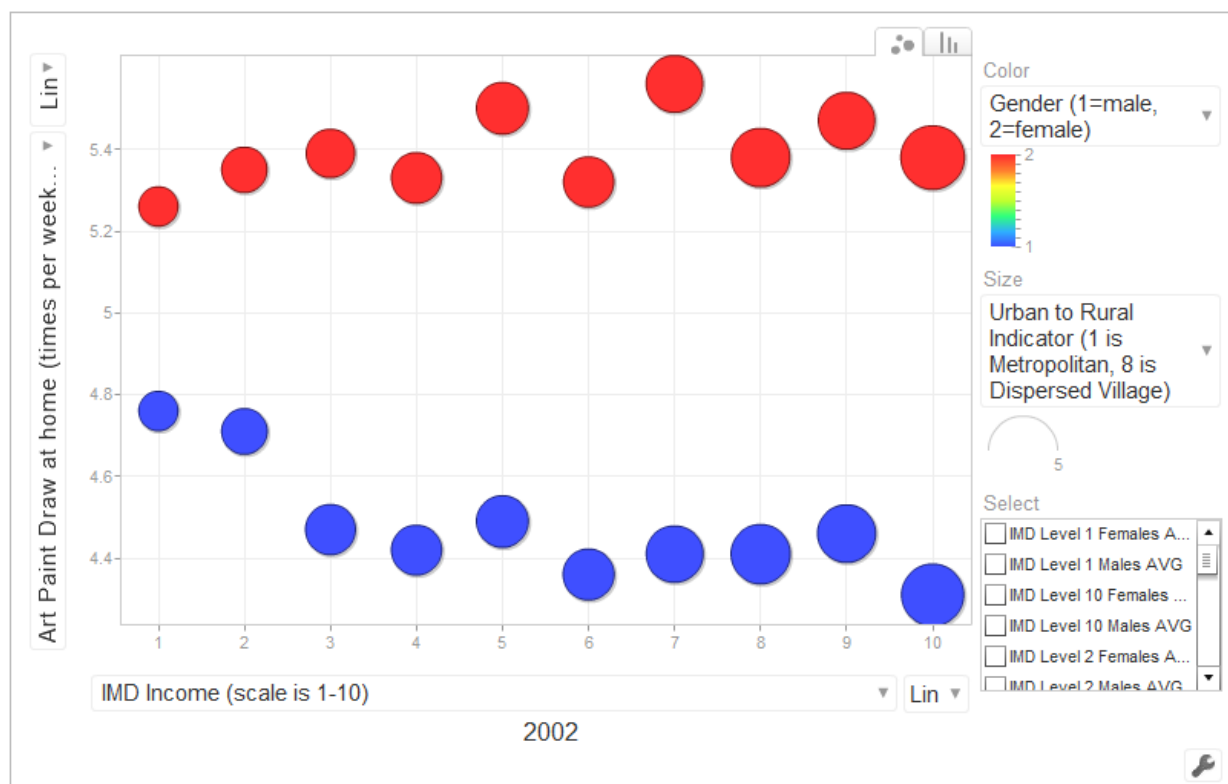


Figure 47. Income versus how often 2-year olds in the MCS populations do art, paint or draw at home. Income has little effect, but girls spend more time than boys at all income levels.

Cognitive learning and social abilities —conclusion

It is commonly accepted wisdom that cognitive testing, and more recently social/emotional testing reveals stronger abilities on the part of children who come from higher income families (Lichtenberger et al., 2000). However, despite years of attempting to remove cultural and social class bias from the evaluative tools that are used, the fact is that the entire testing, or evaluation enterprise, is deeply rooted in the Western culture and Northern countries that develop most of these instruments. In fact, just the idea of standardized evaluation is a peculiarly Western one.

Anecdotal evidence from Ibarra and Prescott suggests that the social behavior of children in a pre-school setting is quite different, with the Ibarra group more prone to spend long periods of time focused on a single activity guided by teachers and their mothers. Cognitive ability is very difficult to compare since little standardized testing is done in Ibarra. However, once basic literacy is reached, which

probably happens at similar rates in both settings, development of deeper reading and writing skills probably is more dependent on the higher educational level opportunities that are available.

In the British MCS, any measure of home-based activities, and especially those involving parents and extended family, shows equal or better participation among low-income families. The results of standardized testing and evaluation all show better performance from higher-income families. However, the source of the tests and the construction of the testing regime must be seriously deconstructed before credence is given to the notion that higher test or evaluation scores indicates some sort of higher ability on the part of the children being tested.

As with pregnancy, childbirth and infancy, early childhood must be difficult when extreme economic poverty precludes the possibility to have significant learning and interaction opportunities at home, or the availability of a pre-school environment to enhance those opportunities. However, once those basic pre-school learning services are in place, then it would appear that higher income and energy use leads to elaboration of the services on the basis of standardized, goal-based outcome desires. In a lower-power-use setting like Ibarra-Ecuador, the outcomes of the pre-school environment are seen as less important than the daily activities that children perform, and the result is that mothers seem more satisfied, and derive higher levels of life fulfillment from the process.

CHAPTER TEN: Conclusions and Recommendations

Humans, like all other animals, may be biologically drive to accumulate more resources. Monetary systems, and the ready availability of fossil fuels, make it possible for humans to accumulate resources far beyond what is needed for their metabolic activities. Together with this biological drive may be a suite of cultural and media-based stimuli that permeate society with the notion that increased monetary resources bring about greater choice in lifestyle, and higher levels of life fulfillment. However, a given income level, and the accompanying power-use level constrain the options that are available to parents, no matter where they might be in the power use space. Most parents, and especially in high-power-use Northern countries, believe they take rational decisions about child-raising practice from a full range of possibilities. But in fact their income and power-use bracket constrain their choices.

Lower-income, lower power-use families tend to use metabolic-level, spiritual and direct-contact approaches to child-raising. As a result, children spend more time at home, interacting with their parents or extended family. Pregnancy and birth tend to be less technified and women report higher levels of satisfaction with their caregivers and the resultant outcomes. Pre-school experiences are directed towards every-day experience and little emphasis is placed on achieving particular cognitive or social-emotional goals for the child. Although lower income children score lower on standardized evaluations and tests, it is hard to know if this reflects some real difference in their abilities, or the biases of the testing system.

Higher-income, high-power-use families tend to find economic, fossil-fuel based solutions to child-raising dilemmas. Children spend more time interacting with technologies including toys and digital screens and with non-family care providers. Pregnancy and birth tend to involve higher levels of technologically based medical interventions and women report lower levels of satisfaction with their caregivers and the resultant outcomes.

Many of the spiritual or direct-contact approaches to parenting are promoted among Northern countries. Medical practitioners are now being encouraged to avoid interventions during pregnancy and child-birth and to work towards bringing down the rate of Caesarian sections. But nonetheless, the high-

power-use system within which they practice, and its concomitant legal and political structure, makes it difficult to argue for not intervening, or not using a tool or procedure that is available. By the same token, despite many years of promoting breast-feeding, rates have not gone up since the cultural-social milieu places higher value on securing income and the energy it represents, than on direct contact with offspring. During pre-school years, high-power-use culture demands performance from children that can be measured, perhaps at the expense of the enjoyment of daily activities.

Alternative lifestyle families and communities in high-power-use geographic regions have had some success in adopting more spiritual, direct-contact child-raising approaches. However, in many cases this happens by reneging their connection to the dominant culture, and even renouncing some part of their economic or income-gaining power. Permaculture homes and co-housing communities often use midwife pre-natal and birth care, women might publicly nurse their children for long periods of time, and local, parent-involved pre-school centers might deliberately prohibit standardized testing and evaluation. However, these families' communities represent a significant minority of the population.

The sustainability movement has often asked that Northern-style families and communities reduce their consumptive lifestyles as part of a "sacrifice" for the common good. The example presented here, of child-raising practices, might shed light on how Northern communities are constrained by their power-use level, and that reducing that level might be the only route towards less economically, fossil-fuel-based approaches to child-raising. The current economic power of these communities should allow them to make a choice, and should allow for the kinds of results shown in this thesis, to guide people towards the renouncement of high-energy-use practices that are actually detrimental and contrary to the accepted norms for healthy child-raising. If an appreciation of this win-win solution, where reducing power use also results in healthier child-raising, can be widely disseminated, the more mainstream communities might comfortably adopt some of the models that Southern cultures still maintain.

An additional step towards disseminating this kind of information should be the inclusion of direct-contact, metabolic-level activities in pre-school centers, along with a demonstrable direct measurement of the effects of those activities that can counter the results obtained from standardized evaluation and

testing instruments. The field of “child development” must be reconstituted in a way that appreciates the importance of daily family contact, metabolic-level, spiritual-type activities, and the possibility that high-intervention, high-power-use activities might actually be detrimental.

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APPENDIX ONE: Sources of Data

The Early Childhood Center Families Data

Ibarra, Ecuador

Data were gathered from 42 government-run early-childhood education centers in and around the mid-size city of Ibarra-Ecuador (population approximately 100,000 people) over a period of two years from 2008-2010, part of that time during which I did an internship in several of the centers. The centers are all run by the Ministry of Economic and Social Inclusiveness (*Ministerio de Inclusión Económica y Social*—MIES) through the Institute for Childhood and the Family (*Instituto de la Niñez y la Familia*—INFA). INFA has a central office in the city of Ibarra and all the centers follow the same administrative and registration protocols, gathering the same data for their client families. Data were released as summary mean averages for each center in order to protect the identity of individual families. In some cases, center directors helped add certain intake or evaluation questions to their routine forms so that additional information or data could be obtained on particular variables of interest. The principal evaluation instrument and data-gathering forms upon which most of the variables are based can be seen at www.esmeche.com

The sample size for each center varies from 15 to 48 families (see Figure A1) and the achieved sample for most variables is 80-90 percent of the total families. These data were all entered into a spreadsheet-formatted database and can be viewed at www.esmeche.com as an interactive online Google Motion Chart (Google Code, 2011), based on the Gapminder utility developed by Hans Rosling (Gapminder Foundation, 2011). Although some variables are assimilated from the previous two years, the entire sample is summarized, in the Motion Charts, as 2010 data, since most of the families in the sample population are registered for at least three years with little change in their basic data. The goal for the present study is to identify important trends in descriptive variables that can be easily visualized. For this reason, analytical statistics like means testing or multivariate analysis were not carried out. In future

studies, more detailed analytical statistics may prove useful in further identifying the strength of trends identified here on the basis of the current descriptive and visual presentation of the data.

Anecdotal data come principally from informal interviews and interactions with families at the centers during my period of internship. In addition, other center employees and teachers were able to fill in gaps in my understanding about certain aspects of family circumstances or children's development and abilities.

As a participant observer, I would not claim that anecdotal data were gathered under a guise of pure objectivity, or within the context of an anthropological approach that aims to remove the observer from the context whenever possible. In fact, in gathering anecdotal data, I have been guided by a single principal observer viewpoint, that which forms the underlying foundation for my thesis. I have looked specifically for those instances when people's expenditure of money or energy—that is their power use—have not brought results in the form of increased life fulfillment. What I have avoided is assuming that I would find this lack of concordance among a certain population, or in a certain setting. And in fact I have often been surprised, not only by instances of economically wealthy individuals and populations misappropriating their expenditures in a way that lowers life fulfillment, but by the same behavior among economically poorer individuals and populations. Although I have tried to distill my observations into a consistent story, especially in comparing the typical Ibarra and Prescott experience regarding child-raising, I cannot claim an easy, and certainly not rational, explanation for much of people's behaviors. At times, the complexity of the ecological/economic system seems overwhelming, and I assume the same must be true for the families I worked with and observed. Their decisions, as well as mine, must at times reflect nothing more than an inability to grasp the full dimensions of the system, and an attempt to carry on, on a daily basis, with what is at hand, and with what seems possible.

Prescott, Arizona

In the Prescott/Northern Arizona area, data were obtained from 23 government-run early childhood education centers (see Figure A2), over a period of three years from 2007-2010, during which time I was a teacher at the Prescott Head Start Center. The entire region has a population of approximately 350,000 with Prescott (“Tri-City Area” population of 100,000 includes Prescott, Prescott Valley and Chino Valley) and Flagstaff (metro area population of 120,000) being the principal urban centers. The centers are all run under the Head Start model, with principally federal-level funding, by a regional governmental entity, the Northern Arizona Council of Governments (NACOG). NACOG has their main office in the city of Flagstaff and all the centers follow the same protocols and gather the same basic data from their client families. Some numerical data was obtainable directly from center directors, but most data were released as mean averages for each center in order to protect the identity of individual families. The principal evaluation instrument and data-gathering forms upon which most of the variables are based can be seen at www.esmeche.com

The sample size for each center varies from 12 to 60 families and the achieved sample rate for most variables is very close to 100 percent since the program requires all participants to complete the same set of forms and evaluations as a condition for receiving services. As with the Ibarra data, these data were also all entered into a spreadsheet-formatted database and can be viewed at www.esmeche.com as an interactive online Google Motion Chart (Google Code, 2011) based on the Gapminder utility (Gapminder Foundation, 2011).

Also, as with the Ibarra pre-school centers, anecdotal data come principally from informal interviews and interactions with families at the center where I worked in Prescott. However, I was able to probe the extent to which the Prescott experience was universal among all the centers through interactions at the frequent district-wide trainings and orientations that were held throughout the year.

Figure A1. List of government-run pre-school centers in the Ibarra, Ecuador region and the Prescott, Arizona region, where data were gathered. The approximate number of families in the sample from each center is given, along with its relative urban-rural indicator, following the British Millennium Cohort Study definitions of urban-rural.

Country	Center Name	Urban-Rural Indicator (*)	Number of Families in Sample
Ecuador	Dr Miguel Egas Cabezas	6	34
Ecuador	Eugenio Espejo (Calpaqui)	5	32
Ecuador	Garcia Moreno	5	26
Ecuador	Gonzalez Suarez	5	28
Ecuador	Ibarra	1	43
Ecuador	Imantag	5	19
Ecuador	Imbaya	7	16
Ecuador	La Carolina	6	22
Ecuador	La Esperanza	6	27
Ecuador	La Merced de Buenos Aires	6	18
Ecuador	Lita	4	31
Ecuador	Mariano Acosta	5	14
Ecuador	Otavalo	2	48
Ecuador	Pablo Arenas	6	16
Ecuador	Pataqui	8	15
Ecuador	Peñaherrera	6	28
Ecuador	Pimampiro	2	28
Ecuador	Plaza Gutierrez	7	20
Ecuador	Quiroga	5	17
Ecuador	Salinas	3	17
Ecuador	San Antonio	3	36
Ecuador	San Blas	5	24
Ecuador	San Francisco de Natabuela	5	25
Ecuador	San Francisco de Sigsipamba	7	28
Ecuador	San Jose de Chaltura	6	30
Ecuador	San Jose de Quichinche	4	17
Ecuador	San Juan de Iluman	4	17
Ecuador	San Pablo	4	32
Ecuador	San Rafael	5	22
Ecuador	San Roque	4	29
Ecuador	Selva Alegre	6	21
Ecuador	Tumbabiro	5	22
Ecuador	Urcuqui	2	27
Ecuador	Vacas Galindo el Churo	7	12
U.S.	Ashfork	3	17
U.S.	Black Canyon City	7	20

U.S.	Camp Verde	3	16
U.S.	Chino Valley	3	31
U.S.	Clark Homes (Flagstaff)	2	32
U.S.	Cogdill (Flagstaff)	2	27
U.S.	Cottonwood	2	19
U.S.	Federated (Flagstaff)	2	22
U.S.	Fredonia	3	21
U.S.	Holbrook	4	18
U.S.	Page	4	24
U.S.	Pinetop	5	20
U.S.	Ponderosa	7	16
U.S.	Prescott	2	56
U.S.	Prescott Valley	2	45
U.S.	Sedona	2	18
U.S.	Show Low	3	26
U.S.	Siler (Flagstaff)	2	60
U.S.	Snowflake	4	26
U.S.	Springerville	5	16
U.S.	St. Johns	7	12
U.S.	Williams	6	36
U.S.	Winslow	3	21
U.S.	Yavapai (Clarkdale)	2	26

*1=Metropolitan

2=Large Town

3=Market Town

4=Other Town

5=Sparse

6=Town Less Sparse

7=Village and Dispersed Sparse

8=Village and Dispersed Less Sparse

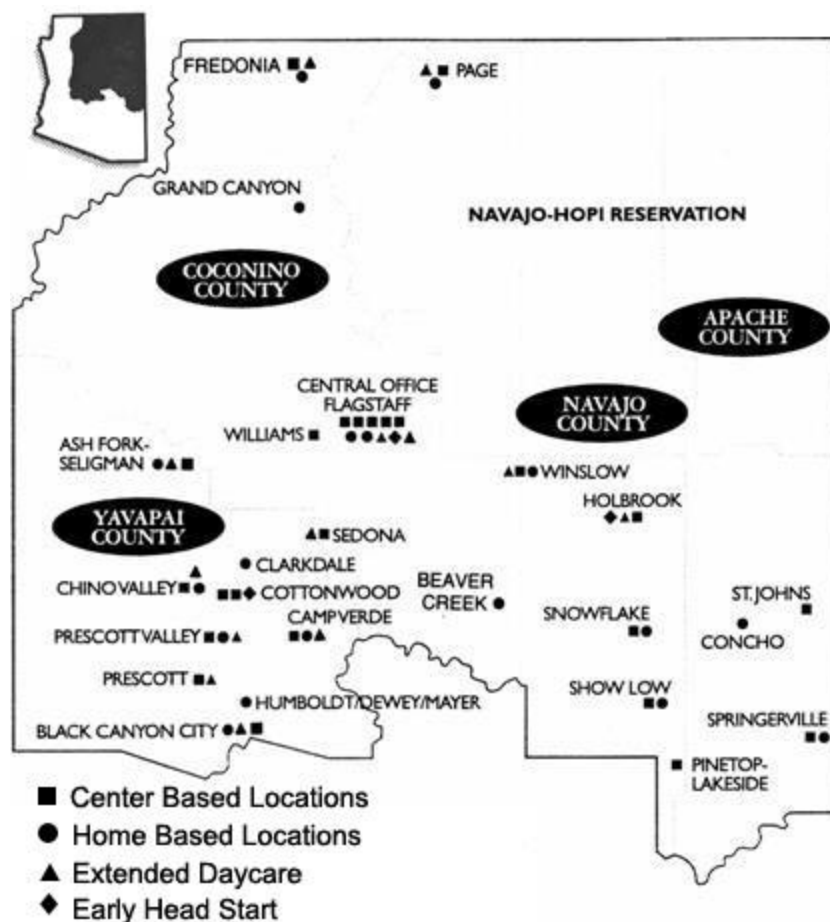


Figure A2. Map of Northern Arizona Council of Governments (NACOG) Head Start Centers. Inset at upper left corner shows location of map relative to outline of state of Arizona.

The Millennium Cohort Data

In the year 2000, the British government initiated its fourth major cohort sequence study (previous cohort studies initiated in 1948, 1956 and 1970) to follow babies born at the start of the new millennium. Called the Millennium Cohort Study (MCS), the initial sample size is over 18,000 families, each with a baby born in the year 2000, from throughout the British Isles. This longitudinal study is a major undertaking and four sample sweeps have now been completed: at 9 months, 2 years, 5 years and 7 years. Each sample sweep includes geographic data, parent interview data, parent questionnaire data, social and cognitive developmental evaluations (for the latest two sweeps) and teacher questionnaire (for the most recent sweep). The study includes tens of thousands of variables and treats almost every aspect of family life: family make-up, economic situation, health care, education, housing, social life,

entertainment, transportation and much more. The sample includes a wide range of income classes and ethnicities, which can be seen in the interactive Motion Chart data tool that I have developed for some of the study data. Detailed information on how variables are defined, along with instructions to data gatherers, and the coding of each variable are available from the Millennium Cohort Study website (Centre for Longitudinal Studies, 2005). In addition, the interview and evaluation instruments, in their entirety, can be obtained through this website. Some of these documents are available publicly with no registration or approval process, and others, especially raw data files, require a registration and approval process to obtain access. In order to facilitate access to the documents that are pertinent to the data analysis performed for this work, access to the interactive data tools are available at www.esmeche.com.

To date, very little of the MCS data have been analyzed, although two very useful publications are available (Dex and Joshi, 2005; Hansen et al., 2010) which provide entry into the contents and some primary findings from the datasets. All of the data are available online through a relatively simple registration process. However, deciphering the multiple data description files and the datasets required intensive review and revision in order to find useful comparative information. Key variables that are related to the trade-offs analyzed in the data chapters of the present work, and that could also easily be visualized as descriptive statistics, were chosen. Each sweep of the Millennium Cohort study has an entirely new set of variables that are sampled, and it is hard to find sequential variables from sweep to sweep. This is in part because the goals of the study evolve, and also because the abilities and characteristics of the children change as they age, especially during the early years. Nonetheless, a few important and revelatory variables that were present for two or more sweeps and are presented here in the data chapters.

Once key variables were identified, they had to be parsed into comparison groups for presenting descriptive means in a useful and visually accessible format. Geographic grouping of the data, as was done for the Early Childhood Center families in Ibarra and Prescott, was not possible because the Millennium Cohort Study policies require high levels of security clearance in order to receive postal-code geographic location data for each family. In essence, only the principal investigators on the study have

access to this information, as a means to protect the identity of individual families and the detailed personal information that the study gathers. However, Index of Multiple Deprivation (IMD) values were assigned to each family, based on the postal code where they live.

The Index of Multiple Deprivation (IMD) is a United Kingdom methodology for analyzing the need for government services in different regions of the British Isle countries. The index currently includes seven different components: Income, Employment, Health and Disability, Education, Skills and Training, Barriers to Housing and Services, Living Environment and Crime. The IMD income metric ranks families from 1-10 depending on their income (1 being low income, 10 being high income). This index serves as an excellent indicator of the family's overall economic situation, which in turn is a good indicator of their energy cycling. The IMD income parameter is also tightly correlated with geographic zones or regions. Each zone and postal code in Britain has been assigned a set of IMD parameters and those parameters were designated to each family in the Millennium Cohort study based on their geographic location.

For the purposes of the present study, I decided to parse the data into the 10 IMD income level and thereby create 10 sub-groups within the sample for comparing means. The IMD income parameter is also tightly correlated with geographic zones or regions and so, although the Millennium Cohort data could not be separated into distinct geographic regions, the IMD income groups each represent a combined set of geographic groups, with the large majority of the families coming from similar geographic environments. Thus, each group of IMD income families that are grouped together to calculate means can be also be considered to come from similar geographic profiles. Detailed information about IMD calculations and geographic distribution is available at the IMD website (Communities and Local Government, 2010). Because IMD calculations for the non-English British Isle countries are different, and because the English families represent approximately 75% of the total Millennium Cohort study, it was decided to only use data from the English sub-data-set. In addition, some of the evaluative tools and interview questions are changed for the non-English countries, including different language options depending on the region.

After calculating means for each income group of each variable, the results were entered into a spreadsheet-formatted database. Comparisons among those data can be viewed interactively in a Google Motion Chart (Google Code, 2011) based on the Gapminder utility (Gapminder Foundation, 2011) which is available on the dissertation website: www.esmeche.com. Some of the variables require more detailed information in order to understand their derivation than what is presented in the graphs that accompany this printed work, or than can be seen in the interactive Motion Chart tool. The origin of each variable and further explanation of the metric, or evaluation tool, that was used by the Millennium Study to define that variable can be seen in Figure A3. Means and standard deviations for all of the Millennium Cohort variables that were analyzed are available at the dissertation website: www.esmeche.com.

Although a relatively small number of variables were ultimately of interest, my income-group-based analysis of these data is the most user-friendly entry into this massive study currently available. When using the interactive Motion Chart data tool, it is important to remember that the IMD income level is the variable that was used to parse the data, and as such it should always be used as a reference for how the data are grouped, either as the x-axis variable itself, or as the size or color indicator for the data points within the chart. For our purposes, since data on family energy use was not directly gathered, income also is our best proxy for family energy cycling or power use. Although wealthier families might save some of their income, and therefore not all the energy represented by their income is cycled immediately, the wealthier income groups are still higher power users than the lower ones and useful comparisons can be made.

These data serve principally, in the context of the current study, to provide a very different reference population for analyzing the tradeoffs between high-level and low-level energy approaches to child-raising. However, this analysis represents a greater achievement. Hans Rosling, one of the co-founders of *Médecins sans Frontières* (Doctors without Borders) has spoken eloquently (Rosling, 2006) of the need to bring the masses of buried, large-scale, often government-gathered data into the light. His foundation, Gapminder, brings massive national and world-scale datasets into a single tool, the Gapminder World, which makes visualization of the data, over time and geography showing fundamental

correlations, available at anyone's fingertips. Rosling's visual data analysis tool, distributed and formatted for ease of use as a Google Motion Chart, is also available, and I've used it extensively for all of my data analyses. In the case of the British Millennium project, however, not only am I using the Gapminder tool for the purposes of the current study, but I am bringing some of the principal data from that project into a format that can be easily analyzed and interpreted, thereby fulfilling Rosling's vision by unburying yet another large dataset and making it publicly available in a useful format.

VARIABLE NAME	UNITS OR MEASUREMENT SCALE	SWEEP(S) MEASURED	MCS INSTRUMENT USED TO GATHER DATA	EVALUATION TOOL USED TO MEASURE DATA
Gender	(1=male, 2=female)	2000	Household Grid	
Number of People in Household	(integer)	2000	Parent Interview	
Urban to Rural Indicator	(1 is Metropolitan, 8 is Dispersed Village)	2000	Geographically Linked Data	
Ethnic Group	(1-3 is white, 4-7 is mixed, 8- 11 is Asian, 12-14 is Black, 15 is Chinese, 16 is other)	2000	Parent Interview	
Year Got Married	(integer year)	2000	Parent Interview	
Index of Multiple Deprivation (IMD) Summary	(integer scale is 1-10)	2000	Geographically Linked Data	
IMD Income	(integer scale is 1-10)	2000	Geographically Linked Data	
IMD Employment	(integer scale is 1-10)	2000	Geographically Linked Data	
IMD Health Deprivation or Disability	(integer scale is 1-10)	2000	Geographically Linked Data	
IMD Educational Skills/Training	(integer scale is 1-10)	2000	Geographically Linked Data	
IMD Barriers to Housing/Services	(integer scale is 1-10)	2000	Geographically Linked Data	
IMD Crime	(integer scale is 1-10)	2000	Geographically Linked Data	
IMD Living Environment	(integer scale is 1-10)	2000	Geographically Linked Data	
Age At Interview	(months)	2000, 2002, 2005, 2007	Household Grid	
Birth Hospital Stay Mother	(days)	2000	Parent Interview	
Pre-Natal Care Start	(week of pregnancy)	2000	Parent Interview	
Breast-Feeding	(months)	2000	Parent Interview	
Birth Weight	(lbs)	2000	Parent Interview	
Baby Stay In Hospital After Birth	(days)	2000	Parent Interview	

Height	(meters)	2002, 2005, 2007	Child Measurement Data	
Weight	(kilos)	2002, 2005, 2007	Child Measurement Data	
Body Mass Index	(kg/m ²)	2002, 2005, 2007	Child Measurement Data	
Vocabulary	(BAS Naming Assessment percentile rank)	2002, 2005	Child Assessment Data	British Assessment Scale (BAS) Naming Vocabulary (Elliott et al., 1996, 1997)
School Readiness	(Bracken Assessment percentile rank)	2002	Child Assessment Data	Bracken School Readiness Assessment (Bracken, 2002)
TV Watching	(hours per day)	2002, 2005	Parent Interview	
Read to Child	(6 is every day, 1 is never)	2002	Parent Interview	
Library Visits With Child	(4 is once/week, 1 is rarely)	2002, 2005	Parent Interview	
Learning Help--Alphabet	(1 is occasionally, 7 is daily)	2002	Parent Interview	
Teaching Songs/Poems/Rhymes Teach	(times per week)	2002	Parent Interview	
Art Paint Draw at home	(times per week)	2002	Parent Interview	
Child Drains Parent Energy	(Subjective Scale 1 is Does Not Apply, 5 is Definitely Applies)	2002	Parent Interview	
Relation Child-Parent is Warm Affectionate	(Subjective: 1 is definite no, 5 is definite yes)	2002	Parent Interview	
Picture Similarity	(T-score)	2005	Child Assessment Data	British Assessment Scale (BAS) Naming Vocabulary (Elliott et al., 1996, 1997)
Pattern Construction	(T-score)	2005, 2007	Child Assessment Data	British Assessment Scale (BAS) Naming Vocabulary (Elliott et al., 1996, 1997)
Personal, Social, Emotional Development	(Foundation Stage Profile scale, 27 is maximum)	2005	Child Assessment Data	Foundation Stage Profile (SureStart, 2003)
Communication, Language, Literacy	(Foundation Stage Profile scale, 36 is maximum)	2005	Child Assessment Data	Foundation Stage Profile (SureStart, 2003)
Mathematical development	(Foundation Stage Profile scale, 27 is maximum)	2005	Child Assessment Data	Foundation Stage Profile (SureStart, 2003)

Knowledge Understanding of World	(Foundation Stage Profile scale, 9 is maximum)	2005	Child Assessment Data	Foundation Stage Profile (SureStart, 2003)
Physical Development	(Foundation Stage Profile scale, 9 is maximum)	2005	Child Assessment Data	Foundation Stage Profile (SureStart, 2003)
Creative Development	(Foundation Stage Profile scale, 9 is maximum)	2005	Child Assessment Data	Foundation Stage Profile (SureStart, 2003)
Foundation Stage Profile Total	(Foundation Stage Profile scale, 118 is maximum)	2005	Child Assessment Data	Foundation Stage Profile (SureStart, 2003)
Cultural Institution Visits	(Different Types of Venues in Last 12 Months--derived variable adding responses, 6 is maximum)	2005	Parent Interview	
Religious Services How Often Child	(1 is least often, 7 is most often)	2005	Parent Interview	
Religious services--How Often Parent	(1 is least often, 4 is most often)	2005	Parent Interview	
Sports/Exercises for Child	(days per week)	2005	Parent Interview	
Sports Exercise Parent With Child	(1 is never to 7 is every day)	2005	Parent Interview	
Computer Use	(hours per day)	2005	Parent Interview	
Indoor Activity Parent With Child	(0 is never to 6 every day)	2005	Parent Interview	
Grandparents How Often See	(0 is not at all, 5 is every day)	2005	Parent Interview	
Family Relatives How Often See	(0 is not at all, 5 is every day)	2005	Parent Interview	
Friends Outside School How Often See	(0 is not at all, 5 is every day)	2005	Parent Interview	
General Level of Health	(1 is poor, 5 is excellent)	2005	Parent Interview	
Parents Time With Child	(5 is too much, 1 is nowhere near enough)	2005	Parent Interview	
Mental State of Parent	(Index sums 6 variables measuring levels of depression, anxiety, 0 is never and 4 is all of the time for each variable)	2005	Parent Interview	
Income	(annual combined gross pay plus self-employed, British	2005	Parent Interview	

	Pounds)			
Reading	(Word Reading Standard Score)	2007	Child Assessment Data	Reading Standards Test
Math Test	(score)	2007	Child Assessment Data	Math Standards Test
I LIKE Index	(derived variable from 6 self "I Like" responses, 1 is not at all, 3 is a lot)	2007	Self Questionnaire	
Speaking/Listening in English	(1 is well below average, 5 is well above average)	2007	Teacher Questionnaire	
Writing in English	(1 is well below average, 5 is well above average)	2007	Teacher Questionnaire	
Science	(1 is well below average, 5 is well above average)	2007	Teacher Questionnaire	
Math and Numeracy	(1 is well below average, 5 is well above average)	2007	Teacher Questionnaire	
Physical Education	(1 is well below average, 5 is well above average)	2007	Teacher Questionnaire	
Information and Communication	(1 is well below average, 5 is well above average)	2007	Teacher Questionnaire	
Expressive and Creative Arts	(1 is well below average, 5 is well above average)	2007	Teacher Questionnaire	

Figure A3 Variables from Millennium Cohort study that were chosen for analysis in the current study. For each variable, the name of the variable, the units of measurement, the survey instrument that was used to gather the data, and where applicable, the evaluation measurement tool that was used in gathering the data are indicated. For the survey sweep child ages: 2000 is 9 months old ; 2002 is two years old; 2005 is five years old; 2007 is seven years old.

National-Level Statistics

Many different sources of data were used for making national-level comparisons of the trade-off parameters of interest. In some cases, prepared graphs, or ready-made datasets were used. In other cases, summary data from different sources were entered into a spreadsheet-style database and analyzed using Google Motion Charts. In each particular case of presenting national or world-level statistics, the reference sources for the data are given.