DESIGN FOR THE MOST VULNERABLE:
REDUCING SUDDEN INFANT DEATH

BY

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THESIS

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Abstract

There has been a significant decrease in Sudden Unexpected Infant Death (SUID) since 1992, which may be a direct result of public awareness programs promoting supine sleep position (e.g. Back to Sleep Campaign). However, over 2000 infants in the United States still die of Sudden Infant Death Syndrome (SIDS) each year. While several risk factors for SIDS have been identified, the root cause(s) remains relatively unknown. SIDS can happen to any infant, regardless of race, gender, and socioeconomic status.

Studies have shown that infants who sleep on their backs in a structurally sound crib are far less likely to die of SIDS and Accidental Suffocation and Strangulation in bed (ASSB). Infants who sleep supine have a lower arousal threshold, increasing their chances of survival during oxygen deprivation. The crib offers a safer sleeping environment than co-sleeping, as the weight of a parent or the soft material of a pillow can easily suffocate an infant.

This thesis discusses and illustrates the design process for a crib that reduces the risk of SIDS and ASSB. The process utilizes empathic design research strategies, benchmarking of current design solutions, and a cross-cultural examination of infant sleep position. The result is a product that carefully considers the product interaction for both parent and child.
Dedicated to the memory of Noah Michael Leibacher
Acknowledgments

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### Definition of Terms

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<th>Term</th>
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<tr>
<td>Sudden Unexpected Infant Death</td>
<td>Infant death that occurs suddenly and unexpectedly, and whose manner and cause of death is not immediately obvious prior to investigation (Department of Health and Human Services, Centers for Disease Control and Prevention, 2009).</td>
</tr>
<tr>
<td>Sudden Infant Death Syndrome</td>
<td>The sudden death of an infant under one year of age which remains unexplained after a thorough case investigation, including performance of a complete autopsy, examination of the death scene, and review of the clinical history (Willinger, James, &amp; Catz, 1991).</td>
</tr>
<tr>
<td>Accidental Suffocation and Strangulation in Bed</td>
<td>Includes suffocation by “(1) soft bedding, pillow, or waterbed mattress, (2) overlaying or rolling on top of or against infant while sleeping, or (3) wedging and entrapment of an infant between 2 objects such as a mattress and wall, bed frame, or furniture; and strangulation by asphyxiation, such as when an infant’s head and neck become caught between crib railings” (Shapiro-Mendoza, Kimball, Tomashen, Anderson, &amp; Blanding, 2009, p. 533).</td>
</tr>
<tr>
<td>Prone Sleeping</td>
<td>Lying on the stomach.</td>
</tr>
<tr>
<td>Supine Sleeping</td>
<td>Lying on the back.</td>
</tr>
<tr>
<td>Lateral Sleeping</td>
<td>Lying on the side.</td>
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Chapter 1

Defining Sudden Unexpected Infant Death

1.1 Sudden Unexpected Infant Death

Sudden Unexpected Infant Death (SUID) is defined as “infant death that occurs suddenly and unexpectedly, and whose manner and cause of death is not immediately obvious prior to investigation” (Department of Health and Human Services, Centers for Disease Control and Prevention, 2009). Subgroups of SUID are: metabolic disorders, hypothermia, hyperthermia, neglect or homicide, Sudden Infant Death Syndrome (SIDS), poisoning, Accidental Suffocation and Strangulation in Bed (ASSB), and unknown causes.

This thesis will mostly focus on Sudden Infant Death Syndrome and Accidental Suffocation and Strangulation in Bed. The distinction between the two is that SIDS deaths are generally considered non-preventable, and ASSB deaths are potentially preventable. While product design might not be able to save the lives of SIDS victims, it can most likely reduce the number of children who die of ASSB. It can also raise awareness of the dangers of SIDS and ASSB, hopefully resulting in safer sleep habits.

1.1.1 Sudden Infant Death Syndrome (SIDS). Sudden Infant Death Syndrome is the sudden death of an infant under one year of age which remains unexplained after a thorough case investigation, including performance of a complete autopsy, examination of the death scene, and review of the clinical history (Willinger, James, & Catz, 1991). This makes SIDS not a diagnosis, but a diagnosis of exclusion (SIDS Network, 2009). Even though there has been a significant decrease in the number of SIDS cases since 1992, it still remains the leading cause of death in children between the ages of 1-12 months (Hunt & Hauck, 2006).
1.1.2 Accidental Suffocation and Strangulation in Bed (ASSB). Accidental Suffocation and Strangulation in Bed, another subgroup of Sudden Unexpected Infant Death, includes suffocation by

“(1) soft bedding, pillow, or waterbed mattress, (2) overlaying or rolling on top of or against infant while sleeping, or (3) wedging and entrapment of an infant between 2 objects such as a mattress and wall, bed frame, or furniture; and strangulation by asphyxiation, such as when an infant’s head and neck become caught between crib railings” (Shapiro-Mendoza, Kimball, Tomashek, Anderson, & Blanding, 2009, p. 533)

Many cases of ASSB can be prevented by safe sleep practices and a safe sleep environment.

1.2 The Triple-Risk Model

There are several theories of why SIDS occurs, but it is likely that it is a combination of several factors that cause these deaths. This is sometimes referred to as the “Triple-Risk Model.” Developed by Filiano and Kinney in 1994, it identifies the three main factors in SIDS as a “vulnerable infant,” a “critical development period,” and “outside stressors.”

![Figure 1.1. The Triple Risk Model (adapted from Filiano & Kinney, 1994).](image)

1.2.1 Vulnerable Infant. There are several prenatal risk factors that are linked to SIDS. They include: teen pregnancy, low socioeconomic status, low level of parental education, alcohol
use, nicotine use, drug use, inadequate prenatal care, subsequent births less than one year apart, overweight infant, male sex, and premature birth (Hunt & Hauck, 2006).

Some newborns are predisposed to SIDS because of certain genetic and physiological conditions. For example, recent testing has focused on the areas of the brainstem responsible for homeostatic functions, such as respiratory drive, blood pressure regulation, thermoregulation, upper airway reflexes, and arousal (Paterson, et al., 2006). These serotonergic neurons in the medulla oblongata also trigger respiration in response to episodic hypoxia (Baker-Herman, et al., 2004). Hypoxia, or deprivation of oxygen, is usually countered with a gasp of air, but children with this brainstem abnormality may cause problems in the child’s respiration, circulation, and circadian regulation (Hunt & Hauck, 2006).

There have been genetic breakthroughs in identifying infants who have this condition. SIDS victims sometimes have mutations in the serotonin transporter (5-HTT) gene (Hunt & Hauck, 2006). Identifying this genetic abnormality could allow doctors to warn parents that their child is vulnerable to hypoxia. However, screening for defects such as these is expensive and not regular medical practice. Currently, the best way to prevent SIDS is through education and safe sleeping habits.

1.2.2 Critical Development Period. Incidences of SIDS peak at 2 months and then decrease to near zero near 12 months. This is a time when infants are rapidly changing and developing. Their sleep patterns are stabilizing and there are also changes in breathing, heart rate, blood pressure, and body temperature (National SIDS/Infant Death Resource Center, 2005).

1.2.3 Outside Stressors. After a baby is born, several factors can increase the risk of SIDS. Some of these include anemia, low birth weight, premature birth, exposure to tobacco smoke, not breastfeeding, elevated or reduced room temperature, cold, flu, infection, exposure to
mold, soft bedding and excess bedding, clothing, and stuffed animals, co-sleeping with parents or siblings, and prone sleep position (Hunt & Hauck, 2006)

1.3 How Many Infants are Affected?

Sudden Unexpected Infant Death and Sudden Infant Death Syndrome are both rare cases. The rate of SIDS was 1.511 per 1000 live births in 1979, and fell to 1.301 in 1991, before the American Academy of Pediatrics started the Back to Sleep Campaign. At that point, the rate of SIDS dropped drastically to .546 per 1000 live births in 2004 (Shapiro-Mendoza, Kimball, Tomashek, Anderson, & Blanding, 2009).

Unfortunately, during the time that the SIDS rate has been falling, the rate of Unknown and ASSB cases of SUID have been increasing. ASSB deaths have more than quadrupled since 1984. This is not to say that infant cribs are less safe now than they were before. The opposite is probably true, since the Consumer Product Safety Commission has been adamant about getting unsafe cribs off the market. The CPSC has recalled 11 millions of cribs for safety issues since 2007 (Consumer Product Safety Commission, 2010).
It is hypothesized that the decrease in SIDS and the rise of Unknown and ASSB deaths is partly due to changes in autopsy coding (Shapiro-Mendoza, Kimball, Tomashek, Anderson, & Blanding, 2009). In 1996, the Center for Disease Control and Prevention released the Sudden, Unexplained Infant Death Investigation Report Form (SUIDRF) with hopes of improving and standardizing the data collected on infant mortality. This form may have led to a “stricter adherence to the 1991 SIDS definition, ie, unexplained deaths that lack a thorough case investigation cannot be classified as SIDS, and thus are classified as cause unknown.” (Shapiro-Mendoza, Kimball, Tomashek, Anderson, & Blanding, 2009, p. 538) Moreover, the requirement
of a strict death-scene investigation probably results in more accurate cause-of-death
classifications. Some deaths that might have been incorrectly classified as SIDS in past, are now
classified as potentially preventable ASSB deaths.

1.4 SIDS and Socioeconomic Status

SIDS affects people of all racial and socioeconomic status, but not proportionally.
African Americans and American Indians are more than twice as likely to die of SIDS. The
lowest SIDS rates are in Hispanic and Asian/Pacific Islander families (National Institute of Child
Health and Human Development, 2001).

One reason for the disproportionate SIDS rate in African-Americans is that African-
American infants are twice as likely to sleep prone as White infants (Ko, Willinger, Hoffman,
Kessler, and Corwin, 2000). and a study of inner-city African-American parenting showed that
“only 54% of families reported that they followed the supine sleep position advice given by
clinic personnel” (Ray, Metcalf, Franco, and Mitchell, 1997). Coleman suggests that the
“currently available public health messages are incongruent with this ethnic group,” which leads
to “persistent nonadherence” (2009).

The most likely infants that slept prone were from African American and Hispanic
families who were poor and without a college education. (Corwin et al, 2003) In 1999, the Back
to Sleep program, which provides education on SIDS and promotes supine sleep habits, shifted
their focus to the African-American community to try to offset the high levels of SIDS. In 2003,
the National Institute of Child Health and Human Development (NICHD) held summits with
three African-American groups, the National Coalition of 100 Black Women, Inc., the Women in
the NAACP, and the Alpha Kappa Alpha Sorority, Inc. to try to promote safe sleep habits.
(Eunice Kennedy Shriver National Institute of Child Health and Human Development, 2011)
Figure 1.3. SIDS death rates and prevalence of prone infant sleeping according to race (adapted from American Academy of Pediatrics Task Force on Sudden Infant Death Syndrome, 2005).

There have also been several initiatives in the American Indian and Alaska Native communities to educate pregnant mothers and provide adequate health care for both mother and child. The Northwest Portland Area Indian Health Board (NPAIHB) serves 43 tribes in the Northwest United States, including Alaska. Their work has led to a reduction in tobacco and alcohol use among pregnant mothers, and a significant decrease in SIDS among American Indians and Alaska Natives (Gaudino, 2008).

SIDS also occurs more frequently in boys, with 60% of SIDS deaths coming in the male population (NICHD, 2001). Paterson found that “male SIDS cases had significantly lower 5-HT binding density in the raphé obscurus compared with female cases” (Paterson et al., 2006). This irregularity in the brainstem might explain why males die more often of SIDS. Another study suggests that females die from hypoxia less likely than males because of an “X-linked dominant
allele that occurs with frequency 1/3” (Mage & Donner, 2006). They suggest that this not only explains less females die from SIDS, but also from Infant Respiratory Distress Syndrome (IRDS) and asphyxiation during childhood and adulthood.

1.5 SIDS and Child Care Centers

Although there has been a decrease in Sudden Infant Death Syndrome deaths, a disproportionate amount of children die while in child care. Of all SIDS deaths, approximately 20% of them happen at child care centers (CCCs) or at family child care homes (FCCHs) (Moon, Kotch, & Aird, 2006). In 2003, the American Academy of Pediatrics’ Healthy Child Care America program started its own Back to Sleep campaign targeting child care providers.

This campaign has been successful in updating many state regulations for child care providers. In 2001, only 6 states had outlawed prone sleeping, but in just two years that number was increased to 26 (Moon, Kotch, & Aird, 2006). Unfortunately, soft bedding and soft objects in bed are only prohibited in 23 states for CCCs and 20 states for FCCHs. Also, only 7 states require SIDS training for CCCs and 10 states require SIDS training for FCCHs (Moon, Kotch, & Aird, 2006).

Despite their efforts, many child care providers still use soft bedding or place infants to sleep prone. Supine or side sleeping is especially important in the child care setting because there is evidence that unaccustomed prone sleeping significantly increases the risk of SIDS (Moon, Kotch, & Aird, 2006). Children that sleep supine at home, but are placed to sleep prone at the CCC or FCCH are more likely to die of SIDS. Many of them die in the first week in child care, and often in the first two days (Kiechl-Kohlendorfer & Moon, 2008).

Two-thirds of all children under 12 months of age receive some sort of child care, and half of these infants spend time in a CCC or FCCH (Moon, Kotch, & Aird, 2006). It is not only
imperative that these children sleep in safe cribs, but also that the child care providers receive the necessary education to properly care for them.

1.6 Discussion

The shift of autopsy coding from SIDS to ASSB means that the number of infants that could potentially be saved by improved sleep conditions is actually much more than was thought in the past. Even though the number of infants that die each year from SUID is a relatively small number, no parent should have to lose a child.

Even though there are facts supporting co-sleeping as advantageous, as long as the American Academy of Pediatrics recommends that the safest place for an infant to sleep is in a crib in the parents’ room, this thesis will focus on creating a separate crib, and not a co-sleeper sidecar that attaches to the bed. It may make nocturnal breastfeeding easier, but it encourages bringing the infant into bed with the parents, which could potentially lead to a parent smothering the child while asleep.

Since sociodemographic factors play a role in SUID, this thesis will focus on an affordable crib that provides a safe place for infants to sleep. It is imperative that every child have a safe place to sleep, regardless of the economic situation of its parents. Through interviews, observations, empathic design research strategies, and a thorough evaluation of existing products, a more appropriate baby bed can be designed.
Chapter 2

Current SUID Prevention

2.1 A Recent Timeline of Sudden Unexpected Infant Death Prevention

In the last twenty-six years there has been much research into Sudden Unexpected Infant Death, with much of this focusing on Sudden Infant Death Syndrome (SIDS). In 1985, Davies wrote that only 0.036 infants die per 1000 live births in Hong Kong, compared to 2-3 infant deaths per 1000 live births in western countries (Davies, 1985). If the same ratio of children in western countries died in Hong Kong as they did in western countries, an estimated 800-1200 would have died, but the number in Hong Kong was only 15 (Davies, 1985). It was hypothesized that this low incidence was caused by crowded living conditions, a lower frequency of preterm births, and a tendency to place babies supine to sleep (Davies, 1985).

Several countries started to take notice and started recommending supine sleeping. In 1987, the Netherlands was first, followed by the United Kingdom, New Zealand and Australia in 1991 (Högberg & Bergström, 2000). In 1992, the American Academy of Pediatrics (AAP) recommended that infants sleep on their backs (supine) or sides (lateral) to reduce SIDS (American Academy of Pediatrics Task Force on Infant Positioning and SIDS, 1992). In 1996, this recommendation was changed to only include supine sleeping (American Academy of Pediatrics Task Force on Infant Positioning and SIDS, 1996).

Following the lead of the AAP, the National Institute of Child Health and Human Development (NICHD) started the Back to Sleep campaign in 1994. Back to Sleep is an educational campaign that encourages parents to place children to sleep on their backs (supine) instead of on their stomachs (prone). In 1992, when prone sleeping was deemed unsafe by the American Academy of Pediatrics, only 13% of U.S. infants slept supine. In 2009, the same
survey showed that 74.1% of children sleep supine (National Infant Sleep Position (NISP) Household Survey, 2009).

2.2 Contradictory Views on Infant Sleep

2.2.1 Co-sleeping. The issue of co-sleeping (adults sharing a bed with infants) is a controversial topic. Proponents argue that it co-sleeping helps facilitate nighttime breastfeeding and leads to more sleep for both the parents and the child. There are also statistics that suggest that co-sleeping might be a safer way for infants to sleep. For example, New Zealand, the Pacific country, has a minority population that comes from the Pacific Islands. Schluter, Paterson, and Percival describe them in this way:

Pacific peoples are generally less advantaged in education, housing, and health compared with their non-Pacific counterparts. As such, Pacific people are frequently overrepresented in the multiple adverse health and social risk factors including low levels of maternal education, low maternal age at birth, poor housing, and large family sizes. These factors have been implicated with the Pacific infants’ higher rates of hospitalization and death (p. 388).

However, even with these disadvantages, the Pacific Islanders have been 1.5 times less likely to die of SIDS than the overall New Zealand rates. While the New Zealand Cot Death Association discourages bed sharing, a study at a hospital in South Auckland, New Zealand, showed that 50% of the Pacific Islanders usually shared a bed with their infant. When combined with the fact that Pacific Islanders have the lowest SIDS rates in the United States as well, it is difficult to discount the way that Pacific Islanders care for their young.

In 2005, the American Academy of Pediatrics reaffirmed its stance that co-sleeping is not recommended. However, they stated, “There is growing evidence that room sharing (infant sleeping in the parent’s room) without bed sharing is associated with a reduced risk of SIDS” (American Academy of Pediatrics, 2005, p. 1248); Bed sharing is still considered dangerous, especially if a parent smokes, is under the influence of drugs or alcohol, or is overtired.
Moreover, they claim that sharing a couch, or having the infant bed-share with a sibling is especially dangerous.

2.3 Product Solutions

There are numerous products and patents that attempt to solve the problem of Sudden Unexpected Infant Death. While there are many products that make infants safer during sleep, there are also products which cause unintended consequences. These products all have good intentions, but the SUID is a difficult and multi-faceted problem. It is doubtful that any single product can keep every child from dying.

2.3.1 Swaddling Blankets and Infant Sleepers. Loose blankets are not supposed to be used in cribs due to the suffocation hazards associated with them. Instead, infants should be swaddled, which is when a blanket is wrapped tightly around the baby. Infant sleepers can also be used, which is a warm jumpsuit that replaces the blanket.

Among these products, the number one seller on Amazon.com is the Gerber Two Pack Infant Blanket Sleeper. They are typical “onesies”, one-piece pajama sets and the pack of two ranges from $7.00 to $10.97. They are designed to keep the infant warm without the use of a blanket. They come in five sizes: 0-6 months, 6 months, 12 months, 18 months, and 24 months (Gerber Two Pack Infant Blanket Sleeper, 2010).

Figure 2.1. Gerber Two Pack Infant Blanket Sleeper (2010).
Halo Innovations, Inc. was started by a father who lost a child to Sudden Infant Death Syndrome in 1991. One of their products, the SleepSack, is described as a “wearable blanket” that prevents rebreathing, which is the inhalation of carbon dioxide. They are sold at major retailers and sell from $19.99 to $39.95. The SleepSack comes in common sizes, but also in a “Preemie” size. Designed for preterm infants, it fits babies 14” -19” long and under 5 pounds (SleepSack, 2010).

*Figure 2.2. SleepSack (2010).*

The best-selling swaddling blanket on Amazon.com is the Summer Infant Swaddleme Microfleece. Similar to the SleepSack, the infant sleeps in a wearable blanket, but it also has two swaddling flaps and wrap tightly around the infant and Velcro in place. The Swaddleme ranges from $8.69 to $17.99 and comes in two sizes: birth to 3 months, and 3 to 6 months (Summer Infant Swaddleme Microfleece, 2010).

*Figure 2.3. Summer Infant Swaddleme Microfleece (2010).*
2.3.2 Restrictive Products. There are several products and patents that focus on restricting infant movement while sleeping. Foam padding can be used to keep an infant in place while sleeping. Other products have been designed to hold babies in a side-sleep position. The problem with these solutions is that if an infant does get loose and rolls over the foam barrier, the product could potentially wedge the child in an unsafe position, suffocating them.

U.S. Patent 5,450,640, awarded in 1995, is listed as an “Infant Sleep Support.” It holds infants in a side sleeping position and keeps them from rolling onto their stomachs. It has a length of fabric that wraps the child, much like a swaddling blanket. This product assumes that an infant will prefer to sleep on its side, however not all children sleep the same.

![Figure 2.4. U.S. Patent 5,450, 640 (Patton & Inniss, 1995).](image)

U.S. Patent 6,553,589, awarded in 2003, is listed as an “Infant Basket for Side Sleeping Support.” A similar product to the “Infant Sleep Support, it also keeps the infant in a side sleep position. It includes a handle on top for carrying. The inventor envisioned this product being carried like a basket and even attaching to the top of a stroller.

![Figure 2.5. U.S. Patent 6,553,589 (Hartman, 2003).](image)
Until recently, several companies sold infant sleep positioners such as the one in figure 2.6, with the intent of saving lives. Not only were they supposed to keep an infant in the supine sleeping position, they also claimed to help “aid in food digestion, ease colic or the symptoms of Gastroesophageal Reflux Disease (GERD), or prevent flat head syndrome (Plagiocephaly)” (Consumer Product Safety Commission, 2010). However, in the last 13 years, 12 children between the ages of 1-4 months were suffocated while using sleep positioners. On September 29, 2010, the Consumer Product Safety Commission and the Food and Drug Administration issued a statement warning parents to immediately stop using sleep positioners.

![Image of a baby on a sleep positioner](image)

*Figure 2.6. Dex Products Secure Sleeper Ultra 3 In 1 Sleep Positioner (2010).*

**2.3.3 Infant Sleep Hammocks.** Amby Baby was a company that sold what they called the “original and safest baby hammock on the market.” (http://www.babyhammocks.com) It was designed to replicate the feeling of sleeping in the womb, creating a more cozy sleep for newborns. However, in 2009, two children were suffocated while using the product. On December 8, 2009, the Consumer Product Safety Commission warned that the hammocks were unsafe (Infant Suffocation Deaths Prompt Recall of Amby Baby Motion Beds/Hammocks, 2009). Amby Baby countered by offering a repair kit for the hammocks, but then went out of business.
2.3.4 Baby Monitors. Baby monitors are used to detect infant motion and vitals. If the baby is in a dangerous situation, they sound an alarm, alerting parents of possible danger. The Graco Angelcare Baby Movement and Sound Monitor is one such product. It uses a 12” x 12” plastic sensor, placed under the mattress, that detects movement, such as the movement associated with breathing. If the sensor does not detect any movement for 20 seconds, it sounds an alarm on a remote unit. The product also includes a thermometer and a sound monitor. Sudden Infant Death Syndrome happens so quickly that it is unlikely the product would save the life of an infant, but it does offer peace of mind for many parents who own it.

U.S. Patent #4,350,166, awarded in 1982, is listed as an “Apnea Detector.” It uses an infrared camera mounted above the crib to detect Carbon Dioxide. Carbon Dioxide is “absorbent
to the long wave infrared radiation” and the camera detects the changes in infrared radiation as the child inhales and exhales (Mobarry, 1982, p. 1). It sounds an alarm if these changes in infrared radiation are interrupted for a predetermined amount of time.

*Figure 2.9. U.S. Patent #4,350,166 (Mobarry, 1982).*

U.S. Patent #6,047,201, awarded in 2000, is listed as an “Infant Blood Oxygen Monitor and SIDS Warning Device.” It is an infant foot wrap that detects pulse and blood oxygen levels. If the product detects vitals at a dangerous level for a certain amount of time, it sounds an alarm. This is another intriguing solution, but the foot wrap could be uncomfortable for an infant and would probably be difficult to Velcro to a child before bed.

*Figure 2.10. U.S. Patent #6,047,201 (Jackson, 2000)*

**2.3.5 Air Circulators.** U.S. Patent #5,389,037, awarded in 1995, is listed as a “Method and Apparatus for Improving the Respiratory and Efficiency of an Infant.” The product is an air
pump that moves fresh room air over an infant’s face, preventing rebreathing of Carbon Dioxide. It is a clever solution to the problem, but the airflow could also cause dry eyes.

Figure 2.11. U.S. Patent #5,389,037 (Hale, 1995)

2.3.6 Pebble Mattress. In 2010, Nook Sleep Solutions started selling a baby mattress called the Pebble. It contains technology that is currently patent pending. There are two versions of the Pebble: Pebble Lite, which sells for $295.00 and Pebble Organic, which sells for $550.00 (http://nooksleep.com).

Figure 2.12. Pebble Organic (2010).

The mattress has a 100% natural latex center, with a hole pattern throughout. Latex is open-celled, which is breathable, but the hole pattern aids in the process. Natural latex is used instead of synthetic latex because it is hypoallergenic, anti-microbial and anti-mite. The latex allows for a soft, spongy center without the use of springs.

This is covered by an “air layer” of nontoxic PETE, followed by and a fire-retardant wool layer. Nook Sleep Systems states that wool is three-times more heat-resistant than cotton, and
also pulls heat away from the child, helping them stay cool. Wool is also a natural material, so it does not expel any toxic gasses.

The outermost layer is a removable zinc-infused eucalyptus fabric that is resistant to microbes, mites, fungi and mold. Nook Sleep Solutions claims that the eucalyptus used on the other cover of the mattress has superior breathability and absorbency than synthetic materials such as rayon and nylon. This pulls sweat away from a child’s skin, allowing them to sleep more comfortably. Eucalyptus is also a fast-growing renewable resource and is extremely soft so it does not damage the child’s sensitive skin. Below this eucalyptus is another breathable yet water-resistant material. This allows for oxygen to travel through the material, but does not allow for liquid such as urine or vomit to penetrate the surface. These liquids can be wiped off the surface with a cloth.

The pebble pattern is used because the uneven surface allows for air to move between the pebbles, and beneath the child’s body. This allows for even more air movement, keeping the child at a comfortable temperature.
Nook Sleep Systems refers to their Pebble mattress as “the most considered infant mattress in the world.” It is certainly an admirable product that gets a maximum amount of oxygen to the child, but the price is too expensive for many parents. The top ten bestselling mattresses on Amazon.com are all priced between $65 and $130. It is possible that a less expensive solution is possible, so that every infant can sleep safely, regardless of their socioeconomic status.
2.4 Crib Regulations

There are three organizations that regulate the standards that crib manufacturers must follow: the American Society for Testing and Materials International, the Consumer Product Safety Commission, and the Juvenile Products Manufacturers Association. While they may play different roles, their goal is the same. They want to keep unsafe products out the hands of parents and give infants a safe place to sleep.

2.4.1 American Society for Testing and Materials International. American Society for Testing and Materials (ASTM) International issues standards for a wide variety of products, materials, systems, and services. Among these are standards for cribs, bassinets, and cradles. However, compliance with ASTM International standards is voluntary unless the Consumer Product Safety Commission adopts the regulations and makes them law.

2.4.2 The Consumer Product Safety Commission. The United States Consumer Product Safety Commission (CPSC) regulates the standards that crib manufacturers must follow. These requirements are annually published in the Code of Federal Regulations (CFR). There are two different sets of regulations for baby cribs: one for full-size cribs and another for non-full-size cribs. If cribs do not meet the safety standards outlined by the CPSC, they are declared “banned hazardous substances” and can no longer be sold. (Federal Banned Substances Act, 1960)

2.4.3 Full-size baby cribs. Full-size baby (FSB) cribs are defined as “a bed designed to provide sleeping accommodations for an infant, that is intended for use in or around the home.” (Consumer Product Safety Commission, 1973). The interior dimensions of a full-size crib are 52 inches long by 28 inches wide.
Currently, there are several regulations referring to cribs with adjustable side rails. These rails lower to help the parent softly place the child in the crib and easily remove the child from the crib. They slide back up and lock in place, preventing the child from falling out of the crib.

When the adjustable rail is in the up position, it must be “at least 26 inches above the top of the mattress support at its lowest position.” When the rail is down, it must “be at least 9 inches above the top of the mattress support at its highest position.” The lock requires either “two distinct actions” or a minimum of 10 pounds to unlock (Consumer Product Safety Commission, 1973). The problem with these adjustable rails is that eventually the hardware fails. If the rails break or flap open, a child could tumble out of the crib or even suffocate.

There are several other provisions to reduce suffocation and limb entrapment. The distance between crib slats must be no more than 2.375 inches. A rectangular block measuring 2.5 inches by 3.25 inches by 3.25 inches should not be able to fit through the gap. Also, there is a “loading wedge test,” where a triangular piece of wood, with sides measuring 2.125, 2.125, and 4.75 inches is forced through the gap with 20 pounds of force. The slats fail the test if the wedge widens the gap between slats to over 2.5 inches.

If the crib is made of wood, there must not be any splinters that can hurt the infant. Also, there cannot be any cracks in the wood that could lead to structural failure. Any paint used cannot have more than .06% lead, as outlined in the Ban of Lead-Containing Paint and Certain Consumer Products bearing Lead-Containing Paint (Consumer Product Safety, 1977). Lead is dangerous when ingested, as can cause permanent brain damage.

The mattress in the crib should measure at least 27.125 inches by 51.625 inches. The thickness cannot exceed 6 inches (Consumer Product Safety Commission, 1973). When the mattress is centered in the crib, there should be no more than .5 inches of space on each side.
This prevents the baby from getting his or her head or limbs trapped between the mattress and a side.

**2.4.4 Non-full-size baby cribs.** Non-full-size baby (NFSB) cribs are defined as “a crib that is intended for use in or around the home, for travel, or for other purposes” (Consumer Product Safety Commission, 1976). The interior dimensions of a NFSB crib are either greater than 55 inches by 30.625 inches or smaller than 49.75 inches by 25.375 inches. These include portable cribs, crib-pens, specialty cribs, unconventionally shaped cribs, undersize cribs, and oversize cribs.

Many of the regulations for a NFSB crib are the same as a FSB crib. One place where they differ is on the height of the sides. On a NFSB crib, the sides at their highest position must be 22 inches above the top of the mattress support at its lowest position. This distance cannot be less than 20 inches with mattress. When the mattress support is at its highest position, the side must be at least 5 inches higher when at its lowest adjustable position (Consumer Product Safety Commission, 1976). This distance cannot be less than 3 inches with mattress.

**2.4.5 Juvenile Products Manufacturers Association.** The Juvenile Products Manufacturers Association (JPMA) is a trade organization that works with ASTM International and the CSPC to develop standardized tests for juvenile products. Manufacturers submit their products to the JPMA for approval, tests are performed on the products, and then they are either granted or denied JPMA Certification. Products that have passed have a JPMA Certification Seal on the box, an indication for parents that the product is considered safe.

**2.4.6 Proposed Consumer Product Safety Commission Changes.** The CPSC approved new crib standards on July 23, 2010. They are based off ASTM F 1169-10 and ASTM 406-10. The most important change is the banning of traditional drop-sides on cribs. ASTM F 1169-10
requires that the sides of cribs be fixed for at least 20 inches from the top of the mattress support. Since full-size crib sides only need to be a maximum of 26 inches from the mattress support, this new regulation makes drop-sides obsolete.

Section 104 of the Consumer Product Safety Improvement Act of 2008 requires new standards to apply retroactively. This means that when these new standards go into effect, any crib that does not comply will not be able to be sold, resold, or donated. The CPSC has expressed concern that the lack of cheap second-hand cribs will inadvertently place children in harm’s way. If parents cannot afford to buy a new crib, they might put their children to sleep in unsafe places such as a couch, a floor, or in an adult bed.

Anne M. Northup, CPSC Commissioner, has expressed concern that because all future crib regulations will be retroactive, crib companies will propose new crib rules to sell more cribs. (Northup, 2010) All child service providers and hotels will also have to purchase new cribs, placing a strain on these businesses. Even though there are unintended consequences of the new rules, the result will be safer cribs.

2.5 Bassinets, cradles, play yards, and hammock regulations

Currently, the Consumer Product Safety Commission has no regulations for bassinets, cradles, play yards, and baby hammocks. However, the ASTM International does have a voluntary standard for bassinets and cradles listed as ASTM F2194-10. On March 24, 2010, the CPSC proposed the adoption of these ASTM standards. These proposed rules, if approved, will be titled 16 CFR Part 1218. They will also include standards for hammocks, an infant device which they currently consider unsafe.
2.6 SIDS Nonprofit Organizations

2.6.1 Cribs for Kids. Cribs for Kids is a safe-sleep campaign started by SIDS of Pennsylvania. They donate cribs to low-income families who cannot afford one. They also distribute educational material on SIDS. It started in Allegheny County, Pennsylvania in 1998 and has grown to 250 programs in 47 states. Parents of newborns can submit a request form and a birth certificate to Cribs for Kids and, if approved, will be sent a free crib free of charge.

In a questionnaire distributed by Cribs for Kids, 100% of the respondents reported that they used the crib they received. More noteworthy is that the majority of the parents would have placed their infant in an unsafe position if they did not have the new crib. 38% would have slept in an adult bed with the parents, 25% would have slept in a bassinet, and the rest would have slept on the floor, in a portable crib, or a playpen (Carlins & Collins, 2007).

2.7 Interview with Eileen Carlins

Eileen Carlins, the Director of Support and Education at SIDS of Pennsylvania, was interviewed on June 25, 2010. She has been educating families on Sudden Infant Death Syndrome for 30 years. She was asked general questions about SIDS and questions about the Cribs for Kids program.

Eileen suggested that a disturbing recent trend is that the number of parents who are co-sleeping is increasing. Not coincidentally, infant deaths from co-sleeping are up. She claims that every death they investigate at SIDS of Pennsylvania involve unsafe sleep environments. When asked her opinion on a type of crib known as a “co-sleeper,” which is a bassinet that attaches to the side of the bed. It allows a mother to easily breastfeed when the baby wakes up in the middle of the night. She replied that they are typically very expensive and infants grow out of it by three months of age, or whenever they can roll over.
When questioned about studies that show babies who sleep on their stomach sleep better and develop motor skills quicker, she suggested that babies who sleep on their back should have “tummy time” to build neck muscles. Development delays could happen with infants who have no tummy time. She added, “It is a fact that fewer babies die on their back.”

Figure 2.14. Graco Pack ’N Play Playard with Bassinet and Changer (2011)

When Cribs for Kids was founded, they donated full-size cribs to those who needed them. They soon learned that the cribs were too big for the small apartments the parents lived in. Many of the recipients were single moms who lived in public housing. They decided to switch to the Graco “Pack ‘n Play.” They chose this “playard” instead of a crib for several reasons. First, Graco has several safety patents on this product. Also, it got the best response during focus group testing. The mothers like that the Pack ‘n Play is smaller than a full-size crib, saying that
“a small baby looks so lonely in such a big crib.” It also requires no assembly, and folds up for storage. The product measures 40” x 28.5” x 33.2” and weighs 25.8 pounds.

Another nice feature of the Graco Pack ‘n Play is that is has a removable bassinet. The baby can sleep in the bassinet until it is 15 pounds or until it can roll over, and then it sleeps in the crib. The Pack ‘n Play crib is large enough to hold a baby until it is one year old, coinciding with the end of the range for SIDS.

She also explained that the term “crib death,” referring to SIDS was used extensively in the African American community. Some African American mothers have said, “I don’t want to put my child in a crib, because I don’t want him to get ‘crib death.’” However, when Eileen asks if they would put him in a Pack ‘n Play, they answer “Yes.”

Cribs for Kids purchases the Pack ‘n Play from Graco for $49.00 apiece and the shipping company Pitt Ohio Express delivers them for free. The money to purchase this cribs comes from donations and various fundraisers. It is possible that if Cribs for Kids had a less expensive crib to sell, they would be able to help more families. Cribs for Kids has given away 10,000 cribs in Allegheny County, Pennsylvania, and to this date none of the children have died from SIDS.

It was explained to Eileen that the focus of this thesis was to design an inexpensive crib that safe and reliable. Eileen was interested in assisting as needed. She suggested additional research articles to read and offered to critique the concepts once they were developed.
Chapter 3

Authentic Human Behavior

3.1 Uncovering Authentic Human Behavior

As seen in Chapter 2, the facts seem clear that sleeping infants are safest when supine in a safe crib. Why do parents and caregivers still allow infants to sleep prone or allow co-sleeping? In order to design a safer crib, the designer must first know the answers to these tough questions.

Uncovering authentic human behavior is not always easy. When asked about the way they interact with a product, users often *describe* the actions in a way that is congruent with the way they actually *use* the product. They may have forgotten the way they accomplish the task, and sometimes may be unwilling to explain the true *feelings*. In other words, people often *say* one thing, *do* another, and possibly *feel* a third way (Elwell & McDonagh, 2011). Designers must gather diverse data to triangulate authentic human behavior. This includes personal interviews, observations, and empathic modeling.

![Image of Authentic Human Behavior](Image)

*Figure 3.1. Authentic human behavior (Elwell & McDonagh, 2011).*
In the below image of the Lowman family, Suzy and Justin, the proud parents of a newborn son, have gathered the family on the couch for a traditional family portrait. They appear relaxed and happy, although the baby boy is visibly distressed. The parents’ genuine feelings most likely do not match the smiles on their faces. It is likely that despite the smiles, the parents are concerned about pacifying their son as soon as possible. The moment caught in the time by a camera cannot document hidden emotions, but through interviews and observations, they sometimes can be uncovered.

*Figure 3.2. Lowman family portrait.*

Chapter 3 is a documentation of the personal interviews, observations, and empathic design research strategies that aided in the understanding of how parents and children interact with the crib.

**3.2 Suzy and Justin Lowman Interview, July 10, 2010**

An interview was conducted at the home of Suzy and Justin Lowman on July 10, 2010. The entire transcript can be found in Appendix B. At the time, Suzy and Justin were parents of two baby girls, Sienna (age 2) and Ruby (10 months) and Suzy was three months pregnant with
the third child, Gabriel. Topics that were discussed included: Sudden Infant Death Syndrome, crib safety, “co-sleeper” cribs, acid-reflux, and the new Consumer Product Safety Commission crib regulations.

Figure 3.3. Interview with Suzy Lowman.

Suzy is a proponent of breastfeeding, and seemed very interested in the idea of the “co-sleeper” type of crib, which she described as

“a sidecar and it has three sides and it’ll make the mattress the level of the parents’ mattress. And then, the important thing is that it has attachments under it that hook under the parents’ mattress so it can’t slide away” (Lowman & Lowman, personal interview).

She described this type of crib as a “perfect combination” of crib sleeping and co-sleeping with the parents (Lowman & Lowman, personal interview). Even though she has never owned a co-sleeper crib, she had pushed one of their regular cribs flush with the bed before. This allowed her to more easily nurse the baby in the middle of the night. Also, they “heard how good it is to have them close. Like, somehow, the parents’ breathing wakes them up too a little bit” (Lowman & Lowman, personal interview).
Suzy has read that nursing is important to preventing SIDS, even though it causes added problems. She said

“I think that’s the number one reason why they say nursing helps, because when you nurse a baby, the baby is just going to wake up, naturally more during the night… and so, it kickstarts their breathing” (Lowman & Lowman, personal interview).

She described them waking up so often to breastfeed as “such a pain”, although after a while it is only once a night, and close to morning, so she was “ok with it” even though she was “kinda tired of it now because I am pregnant” (Lowman & Lowman, personal interview).

Suzy also brought up Gastroesophageal Reflux. (GRE)

“Sienna had acid-reflux when she was a kid, and actually, she just really couldn’t sleep on her back, because it would come up all the time, so she slept on her belly very early, actually. We just took that risk because we knew she’d wake up to nurse and stuff. So there’s always lots of scenarios like that, you need to try not to feel guilty” (Lowman & Lowman, personal interview).

There seems to be confusion about how to handle children with GRE. During my conversation with Eileen Carlins, she mentioned that even if children have GRE they should never be put to sleep on their stomachs. It actually makes them more likely to choke on their vomit. However, Suzy and Justin tried to put Sienna to sleep supine while inclined from a pillow under the mattress. They also tried to have her sleep in a car seat. She did not like sleeping in these positions though and the GRE was less active when she slept prone. This was an interesting insight on the compromises that parents have to make when trying to get their infants to sleep.

Suzy and Justin own a Graco Pack ‘n Play, the crib that Cribs for Kids currently distributes. I asked her opinion on the product and specifically about the bassinet feature.

“We have a Pack ‘n Play that’s a little smaller and it’s kind of like a play pen and you raise it up, and it kind of works like a bassinet, but it’s like a bigger space. But they couldn’t be in there very long, because the Pack ‘n Plays, and other bassinets, they usually only go up to ten pounds. And your baby gets to ten pounds so fast. So, by then they need to be in a crib. What’d
kind of interesting though, that we discovered about bassinets, over Pack ‘n Plays, is if you truly want to get them to sleep on their own when you first bring them home, it’s almost as if the crib is too big, like the extent that the space is though, cause kids are used to sleeping a ball and stuff. I think they feel more secure in like a bassinet or something, but like I said, it just doesn’t last very long. It’s a useful thing, but you grow out of it so fast” (Lowman & Lowman, personal interview).

This is similar to Eileen Carlin’s comments that parents tell her that babies seem so lonely in a big crib.

Without prompting, Suzy brought up her concern regarding the new Consumer Product Safety Commission drop-side crib regulations and how it will affect placing her children in their cribs.

“…with being pregnant and having to lower Ruby in…if I wasn’t I think it would still be an issue, like it would still be hard to, you know, when I put Ruby in, she’s not quite asleep, and I think that’s what most people try to do to get them to sleep on their own. They’re not quite asleep, but they’re relaxed, and you want to put them in, but with the mattress being so low, it’s more of a challenge. And now especially, even being a little bit pregnant, it’s like I don’t think I could do it on my own. I’d have to have Justin do it because it’s just, you know, it just hits you at a funny spot. And she’s not happy and I’m not happy” (Lowman & Lowman, personal interview).

It seems that the ban on drop-sides will create challenges for crib manufacturers and parents alike. However, it is an opportunity to create cribs that have less moving parts and are safer for infants.

3.3 Observations

In the interview from July 10, 2010, Suzy Lowman discussed how uncomfortable placing her children in the crib was, especially while she was pregnant. The below images show Suzy placing her three month old son in the crib. It is a crib with drop-down sides and the mattress has been raised to its highest point because the child is too young to pull himself out. The images show how far Suzy has to bend to place the baby in the crib. This could result in back strain or making it difficult to gently place the child in the crib without waking him or her up.
Suzy was also observed placing her son into another drop-side crib. In this crib, the mattress is lowered as far as it will go and the rail is lowered. It was expected that she would have to bend over further to place the child in the deeper crib, but in reality she has just outstretched her arms further to place the infant in the deeper crib.

It was also important to observe the assembly of a portable crib, similar to the Graco Pack ‘n Play. A student, who was selected for her small stature, was asked to carry the crib and a weighted baby doll at the same time, and then set the baby down and assemble the crib. She
clearly struggled to carry the crib, and exhibited poor posture while doing so. Assembly and disassembly did not go much better, as she quit after encountering problems with the locking mechanisms. The observations can be summed up by her quote, “This thing makes me feel stupid.”

*Figure 3.6. Observing Yi Liao carry and assemble portable crib.*

### 3.4 Empathic Design Research

Even though interviews and observations were conducted, there is no comparison to firsthand experience. Sometimes interviewees misremember experiences or answer questions a certain way to avoid embarrassment. Aware of these discrepancies, designers must blend personal interviews with empathic design research strategies if they are to fully understand the design problem.

In this case, empathic design research strategies were used to replicate the experience of parenthood. Since newborns only sleep for 3 to 4 hours at a time, the sound of a baby crying was set as a cell phone ringtone and rang at 11 pm, 2 am, 5 am, and 8 am. When the baby cried, the designer/researcher, furthermore known as the ‘parent’ woke up, turned the alarm off, and cared for the infant for ten minutes before returning to bed. This was done to understand the disruption of sleep patterns and the difficulties that arise with caring for an infant at that time of night.
The parent kept a journal, and took pictures of his appearance at the given times. The entire journal can be found in Appendix C. At each interval, he wrote a keyword on paper that described emotions he was feeling and held it in front of him for the picture. The following morning he wrote in a journal before going to class so that he would not forget the experiences from the night before.

The doll is filled with Morton Rust Remover Salt Pellets to simulate the weight of an infant. The doll is 17 inches long and 7 pounds. This is a little smaller than an actual infant at birth, but it worked for the empathic modeling. The added weight makes the baby feel more realistic, although the pellets made her lumpy.

The crib used was a Cosco Funsport Play Yard. It was chosen because it is similar to the Graco Pack ‘n Play that Cribs for Kids distributes. It is a collapsible mesh play yard with a polyurethane foam mattress that is covered in plastic. The crib is certified by the Juvenile Products Manufacturers Association, acknowledging that it follows all ASTM International regulations.

3.4.1 Crib Assembly. The parent rearranged some furniture in the bedroom to make room for the play yard. He moved the dresser across the room which meant the night stand had to be moved to the bathroom. This immediately made both rooms look unorganized and haphazard.

Although he had previous experience years ago, constructing the crib was easier than expected. It comes in a drawstring bag, wrapped in its mattress. There are two Velcro straps that keep the mattress in place. He unstrapped the mattress and set it to the side, then started to unfold the play yard. As he stood the product upright, the collapsible edges started to lock in place. With this added stability it was able to stand on its own. Then, the floor was pushed flat
in the center, pushing the legs outward from the center, which locks the product in assembled fashion. Finally, he laid the mattress in the crib. Even stopping to take pictures of the process, it still took the parent less than three minutes. Assembly was intuitive and required no instructions, even though they are printed on the inside of the crib.

Figure 3.7. Designer/researcher assembling portable crib.

3.4.2 Re-creating Parental Sleep Patterns. Once the crib was assembled, the first thing the parent did was turn off the lights. Even with two nightlights in the room, he could barely see the crib at all. He had to turn the light on in the bathroom and leave the door open a crack for safety reasons. Afterwards he remembered thinking that it was a good thing that the crib was in the corner of the room, a place where it is hard to trip over or stub his toe on in the middle of the night.

In the journal, the parent noted that he was anxious to start the experiment. Graduate school is already stressful enough, and he was concerned about how breaking up his sleep patterns was going to affect his mood and behavior. However, he was also interested in how patient he was going to be when the baby started crying at 2 am. This apprehension is probably similar to the feelings that parents have on the first night after bringing their newborn home from the hospital. The parent went to sleep earlier than normal, to offset the breaks in his sleep.
At 2 am he woke up to the sound of a crying baby. In the journal he remembered being tired, angry, confused, and frustrated all at the same time. Surprisingly, he was able to see everything in the bedroom. His eyes completely adjusted to the darkness while sleeping. He turned off the crying alarm and carried the infant around for 10 minutes with the lights on. This was the worst part of the experience. Not only did it hurt his eyes, but it started to wake him up. He did not want to feel alert and awake, because he needed to fall back to sleep as soon as possible after taking care of the baby.

At 5 am the baby cried again and for some reason, even though he was tired, he began to feel empathetic for both the baby and parents who do this every night. The baby does not have any means of communication other than crying when it is scared or uncomfortable. It is the only way for the child to get help.

The parent was so exhausted the next morning that he hit snooze four times before he woke up. This was so small feat, because his cell phone alarm was in the crib on the other side of the room. He got out of bed four times to shut it off, each time returning to the bed to fall back to sleep.

The parent taught Junior Design Studio that day. He yawned through the students’ presentations and was exhausted to the point of headache and nausea. Eventually he gave the class a five minute break and went outside to get some fresh air and a drink of water. Luckily, his afternoon class was cancelled so his work day was over. He walked back to his apartment started homework, and drank an entire pot of coffee.

The empathic design experiment continued for 7 days. Over that time, the parent learned some ways to make the process more comfortable. For example, when turning on the lights, he first cracked the door to the bathroom, reached in and turned on the lights. This helped to get
acclimated to the lights before fully illuminating the room. As much as he hated turning the lights on, in reality if a diaper was soiled, he would need light to properly change it.

The parent found waking up so many times in the middle of the night disorienting. Sometimes he was confused about which day it was or whether it was actually morning or evening. This culminated on the morning of October 4 when he woke up in a panic because there was no alarm ringing. Sure enough, the alarm read 9:03 am. Class started at 9:00 am. He did not even shower and was still a half hour late for class. He recalls having no recognition of turning the alarm off, but imagines he just grew numb to having an alarm wake him up every three hours. He was embarrassed walking into class late and blaming it on the baby keeping him up all night.

Since the parent lives alone, the experience is more similar to a single parent than a dual-parent household. There is no sharing of the nighttime responsibilities. It was his job to take care of everything. Even in dual-parent households, if a mother chooses to breastfeed instead of using formula, she would have to do most of nighttime care. The father can change diapers or help soothe the baby back to sleep, but he obviously cannot produce milk. This is why some parents decide to co-sleep. That way, they do not necessarily need to be awake while the infant is nursing. There were times when the parent was so tired that he considered laying down in the bed with the baby next to him instead of walking with him for 10 minutes. He questioned whether he would roll over on the doll during sleep. However, he decided not to chance it, as the thought of waking up on a smothered baby, even a doll, was haunting.

As the week continued, the parent noted that it became increasingly difficult to find motivation to take care of a doll. There were times where he would wake up and care for the baby as if it was alive, and other times he was just too tired to care. Several times he failed to
stay awake for the entire 10 minutes before returning to bed. The parent also started to feel indifferent to the sound of the baby crying. He recorded in the journal that one of the downfalls of empathic research is that in the back of his mind, he knew that he could leave the make-believe world whenever he wanted. It was a safety net that stopped him from full immersion.

Waking up on the last day he felt relief, but was too tired to appreciate it at the time. He does remember thinking that the full night’s sleep that evening was going to be wonderful.
Figure 3.8. Designer/researcher recreating infant sleep patterns.
3.5 Discussion on Recreating Infant Sleep Patterns

One realization the parent had during this process was how unforgiving taking care of an infant is. The baby does not know if the parent had a bad day, is depressed, or slept poorly the night before because the neighbors were noisy. The baby is still going to wake up at least twice a night needing assistance. The baby has complete reliance on the parent, and it is exhausting. Sleep deprivation can lead to poor decision making, such as co-sleeping or placing the infant to sleep prone.

During the empathic design research the parent’s mood changed from apprehension to anger and frustration, then to resignation, and ended in indifference and then relief. As much as he tried to imagine the infant as a living and breathing child, it still felt like he was just going through the motions. He did not talk to the doll like a normal baby and was less patient than he would be with a living child. In the end, it was impossible to replicate the emotional connection between a parent and his child. Also, the alarm sounded at regular three-hour intervals, which did not accurately portray the unpredictability of parenthood.

There was still much to learn from this experience though. While there are few ways to make the baby sleep longer at night, there are still ways to make the parent more comfortable. The first is how to address the pain from turning on the lights. The second is how to help the parent care for the child and return to sleep as soon as possible. Carrying a child for ten minutes is tiring, and the doll that was used was only 7 pounds. If it was a 25 pounds child, it would be much more exhausting. Then, the parent has the tough task of gently placing the child back to sleep in the crib once she falls back to sleep. These are all design opportunities that must be addressed through conceptualization.
3.6 Re-creating Travelling with the Infant

The second empathic design experiment was to take the baby and all its necessities to school. The purpose of this was to better understand the difficulties associated with carrying everything to and from the car. The designer/researcher, heretofore known as the parent packed a diaper bag with baby blankets, a bottle, diaper rash ointment, a diaper-changing mat, a bib, and diapers. He also carried his own backpack, the crib, and the baby.

He woke up almost an hour early so that he would still make it to his 10 am meeting on time. The first step was disassembling the crib. This process was more difficult than expected. He started to unlatch the collapsible sides first, but the proper order is to remove the mattress, collapse the floor, and then unlatch and collapse the sides. At first, he forgot that the crib is transported wrapped in its mattress, so he was looking for the drawstring bag. He soon remembered, and folded the mattress around the crib and fastened the Velcro straps. The underside of the mattress has some nylon handles sewn into it, which is convenient for carrying, although the thin straps hurt the hand while carrying the crib long distances.

The first thing the parent noticed is that it takes a lot of planning just to get out of the house. He needed to think about what order he picked up the items and set them down. He put the backpack on first because it still allowed him the full use of both arms. Then he picked up the diaper bag and put the strap around his neck. This was not as easy, since the backpack already occupied the area where the diaper bag naturally wanted to sit. Then he picked up the baby, and shuffled her to his right arm. Last he bent at the knees and picked up the crib in his left arm. Unfortunately, he was only able to walk a few feet to the door before setting the crib down again so he could open the door. He had to set the crib down every time he needed to use my left hand, which was to lock the door, activate the elevator buttons, to unlock the car and
open the trunk, and to get the child into the car. He was already sweating before getting to the car.

The process was done in reverse when he got to the studio, with one exception. The parent did not have a place to lay the baby down while assembling the crib. Instead he asked one of the graduate students to hold her while he assembled it. It took him less than a minute to set up, and she was back in the crib again. The parent realized that he would not need any assistance if he had a car seat to carry her, so one was borrowed for future empathic modeling.

Figure 3.9. Designer/researcher recreating travelling with an infant.

3.7 Discussion on Travelling with an Infant

The worst part of traveling with the portable crib is having to set it down every time the hands are needed. Carrying this extra weight and repeatedly bending at the knees is exhausting. Also, the crib is not as light as it could be. With some lighter materials and simpler construction, it could be easier to transport.

The problem with this crib though, is that the floor is so low to ground that it is difficult to gently place the baby in it. If a parent had back problems, was pregnant, or was disabled this
would be difficult or impossible. This is the advantage of full-size cribs with drop-down sides. They place the baby at a much more comfortable height for lifting.

There are design opportunities to make portable cribs easier to transport. They could be lighter, and could have less steps for assembly and disassembly. Portable cribs can also benefit from a mattress height that is further from the ground. This could help reduce strain on the back when lowering the child into the crib and when lifting the child out of the crib.
Chapter 4

Case Study: A Safer Crib

4.1 Brainstorming

With the research segment of the design process complete, it was time to start designing a safer and more intuitive crib. The first segment of the design process was brainstorming. Mind maps and mood boards were used to quickly identify the most important features of the crib.

4.1.1 Mind maps. Mind maps focus on the main design features of the product. This mind map also has a hierarchy, much like an internet tag-cloud, with the more important features larger and the less important features being smaller. The main features identified in this mind map were safety, cost, comfort, and sustainability.

![Mind map](image)

*Figure 4.1. Mind map.*

4.1.2 Mood boards. While mind maps focus on features, mood boards focus on emotions. Google image search was used to find images that symbolized the emotions the product should convey. Parents are concerned with their child’s safety, and a calm and safe looking crib could help soothe some anxiety. When looking at the images on the below mood
board, words like tranquility, serenity, and calmness come to mind. Not surprisingly, these words are antonyms to the adjectives that were written on the cards during the empathic design research modeling. Also, the prevalent colors in the image, such as white, light blue, pink, and peach, could serve as inspiration for the color of the final product.

Figure 4.2. Mood board.

4.2 Design Intent

After the progress made by the initial brainstorming sessions, a list of design objectives was devised. The project was divided into two parts: the overall shape and the mattress. Creating a safer mattress could potentially save the life of a child who is sleeping prone, and the remaining structure holds the mattress in place. The overall shape must:

1. be simple and intuitive to use.
2. grow with the child.
3. have a minimal number of moving parts.
4. allow the parent to gently place the infant in the crib.
5. allow easily lifting of the infant from the crib.
6. be durable and easily washed.
7. communicate calm and comfort.
8. be easily assembled.
9. conform to current CPSC regulations.
10. be recyclable.
11. be affordable.

The specifications of a successful mattress design are:
1. support the weight of the infant.
2. be breathable, even if the infant is face down.
3. be comfortable for the child.
4. be waterproof.
5. be durable enough to withstand sharp fingernails.
6. be easily cleanable.
7. be affordable.

4.3 Design Inspiration

In the book The Ten Faces of Innovation: IDEO's Strategies for Defeating the Devil's Advocate and Driving Creativity Throughout Your Organization Tom Kelley and Jonathan Littman write that “cross-pollination” is essential to finding creative solutions (p. 68). Taking innovations from unrelated fields and applying them to the problem at hand is a great way to find inspiration during conceptualization. There were several products that inspired the crib redesign.

4.3.1 Herman Miller Aeron Chair. Most importantly, to solve the suffocation hazards associated with prone sleeping and soft mattresses, a solution for a breathable mattress was needed. Inspiration was found in the Herman Miller Aeron Chair, which is an office chair with a suspended mesh seat. Herman Miller reports their mesh material to be “virtually transparent to airflow and heat transfer” (Herman Miller, 2009). Such a material would not only keep the child
at a comfortable temperature, but could potentially save an infant’s life if the child is sleeping face down.

Figure 4.3. Herman Miller Aeron Chair (2011).

4.3.2 Tub Tub. The Graco Pack ‘n Play is the crib/bassinet combo that Cribs for Kids distributes. However, Suzy and Justin Lowman, owners of the Graco Pack ‘n Play, explained that once their children outgrew the bassinet feature, it was thrown in the closet. It was useless until they had another child or gave the crib to another family. A better solution would be to have a crib that doubled as a bassinet without the wasted material.

A clever solution to this problem of creating a product that grows with the child is the Tub Tub, a baby bath designed by University of Illinois at Urbana-Champaign senior Teddy Lu in 2009 (Forrest, 2010). One half of the baby bath is larger than the other. Once the infant outgrows the small half, the parents use the larger half. The inspiration from the Tub Tub led to concepts where a bassinet flipped over to become a crib.
4.3.3 **11.** The overall shape of the crib was inspired by a luxury foosball table named *11*. The sides of the table dip in the middle, leading to its elegant and soft shape. However, a similar shape could help the caregiver place the child in the crib, since the sides are shorter in the middle (http://www.11thegame.com).

![Tub Tub](image)

*Figure 4.4. Tub Tub (2010).*

**4.4 Conceptual Sketches and Sketch Models**

Rapid sketches and scale models were done to quickly conceptualize the overall shape of the crib/bassinet. The goal of the sketches and models was to quickly come up with many options for the overall shape of the crib. Speed is important at the beginning of the design process because the majority of the concepts at the beginning never make it to the final version.
As the design process progresses, the sketches, renderings, and prototypes will become more defined.

**Figure 4.6.** Conceptual sketches.

**Figure 4.7.** Sketch models.

### 4.5 Computer Modeling

The 3-dimensional computer modeling software SolidWorks was used to further refine the shape. One benefit to refining the concept using computer modeling is the ability to work in full-scale. Designing an infant crib requires wall heights and spaces between slats to be specific
dimensions according to safety regulations. SolidWorks allowed the designer to modify the overall shape, while still working within the given parameters outlined by the Consumer Product Safety Commission.

![SolidWorks refinement](image)

**Figure 4.8.** SolidWorks refinement.

### 4.6 Mattress Material Testing

Many types of mesh were tested for the mattress design. The materials not only needed to be breathable, but durable and easily cleanable as well. The material that will be used will also have to be certified as safe by the Food and Drug Administration (FDA).

![Types of materials tested](image)

**Figure 4.9.** Types of materials tested.
24” x 36” frames were built and mesh was stretches like a canvas over it. Then, a 30 pound weight was placed on the mesh to see how much the mesh deflected. When this happened, some of the materials, especially the speaker mesh, tore or had runs when under stress. Material testing is ongoing, after realization that the mesh needs to hold up to animal claws as well as human fingernails. It is possible that a metal mesh will have to be used instead of a fabric mesh.

Figure 4.10. Material testing.

A less simple, but more likely alternative to this mesh solution is to add an additional mattress on top of the mesh. This mattress would keep the baby away from the mesh, which could hurt its skin. It would also create an insulation barrier, to keep the baby warm in a cold room. However, adding a mattress presents additional suffocation hazards, because a child could bury its head in it, or it overlay on the baby. It is important that this mattress also be made of breathable material, so this cannot occur.

This mattress could be made of polyester filter media. Filters are designed to allow air flow with little resistance. Polyester is also easily washable and dryable. If this mattress gets soiled, it could be placed in a washer and dryer, or cleaned in a shower. However, the washing of this polyester mattress would deteriorate the material over time. Moreover, the ammonia in
urine or the acidity of vomit could expedite this process. It will be important to find the correct material to withstand the use and abuse this mattress would take.

Air flow testing will be essential to proving that the new mattress is safer than existing mattresses. It is possible to produce air flow on one side of the mattress and then measure that air flow on the other side. If the air flows through the new mattress than existing mattresses, then the designer could claim that it is more breathable, and could potentially save lives in a traumatic situation. The designer, however, would not want to claim that children could now safely sleep prone, because it could lead to a lawsuit if the unfortunate event of an infant death did occur.

4.7 Refined Concept

The proposed crib is a combination of a crib and bassinet. Once the infant outgrows the bassinet, the product can be flipped over to utilize the deeper crib side. This solution does not use any additional material, unlike the Graco Pack ‘n Play, which uses additional fabric and wood to form the removable bassinet.

![Figure 4.11. Computer rendering of refined concept.](image-url)
The overall shape is soft and organic to achieve a sense of calm and comfort. The long sides of the crib dip in the middle to create a low spot where the parent would place the child in the crib. These walls still meet all CPSC regulations. The distance between the inner and outer wall of the crib is one inch; however, on both the crib and bassinet side, the walls have a thick return on top and become flat. This gives the illusion that the crib walls are thicker than they are, giving the parent comfort that the crib is safe.

The slat design was chosen to bridge the modernity of a plastic organic crib with the look of a traditional wooden crib. The intent is that the consumers, who likely slept in a wooden drop-side crib when they were a child, get a reminder of their childhood, but also view the crib as a modern interpretation of what a crib should be. Slats have the practical element of making it easier to see the child, and the fanning shape of these slats tie the design language together, by referring to the draft of the crib’s outer walls. The span of the slats only reach the mattress level, delineating the space where the crib meets the bassinet. This visual cue tells the audience that this single product serves two distinct purposes.

The color white was chosen because of its sense of cleanliness. The inside of the crib can get dirty from a variety of reasons, and a white surface makes it easier to identify soiled areas that need cleaning. The color not only appears hygienic, but could also help the caretaker keep the crib more hygienic. While white was chosen, the crib could be molded in plentitude of colors if needed.

A light texture would appear on the parts. Texture is important for many reasons. First, it hides imperfections in the molding process. If the plastic is molded at an incorrect temperature, streaks could appear in the material. Texture helps hide those cosmetic flaws by scattering reflected light. A light texture also makes the plastic more pleasing to the touch.
important, however, that the texture not get too rough, or the product will look too industrial and
the texture will collect dust, making the baby bed harder to clean.

The product is comprised of four rotationally molded parts and the mesh mattress frame.
Since the sides are mirrored, there are two molds that create the four structural parts. These four
parts are held together with eight 4” bolts. These bolts could be locked in place by threading
them through insert-molded nuts, molded into the caps. However, a cost-effective solution is to
use loose nuts, and manually thread the bolts through the nuts.

Figure 4.12. Crib assembly.

The mesh mattress would be stretched over an injection molded plastic frame, and then
ultrasonically welded in place. By heating up the plastic, the mesh and frame would fuse,
ensuring that the mesh cannot separate from the frame. This process is essential to the safety of
the crib, as a mattress failure could cause a child to fall, become entrapped, or suffocate.
4.8 Orthographic Dimensions

The overall dimensions of the crib are 58.42” in length by 33.74” in width by 41.67” tall. The distance between slats is less than 2.375” according to CPSC regulations. The dip in the middle of the crib lowers the height of the crib to 37.5” from the ground, while allowing for a 22” wall height on the crib side and a 10” wall height on the bassinet side.
Figure 4.13. Crib-side-up Orthographic.
4.9 Anthropometric Data

4.9.1 Infant Data. It is important to know whether or not the crib and bassinet are made to the correct dimensions to hold the child. The interior of the crib was dimensioned according
to the Consumer Product Safety Commission regulations for full-size cribs. Relying on this data is important to designing a safe and comfortable crib.

The wall height on the bassinet side is 10” tall to comply with the 9” bassinet wall height regulation. Bassinets are often designed to hold babies until they are fifteen pounds or until they can roll over. At birth the male is between 5 and 10 lbs. The average is 8 lbs. At birth the female is between 5 and 10 lbs. The average is 7.5 lbs. The male would be expected to reach fifteen pounds and outgrow the bassinet between the 2\textsuperscript{nd} and the 7\textsuperscript{th} month. The average is the 4\textsuperscript{th} month. The female would be expected to reach 15 lbs. between the 3\textsuperscript{rd} and the 9\textsuperscript{th} month. The average is the 5\textsuperscript{th} month (Department of Health and Human Services, 2000). Given this data, it would be expected that the infant should be able to remain in the bassinet past the time two-to-four month time frame when SIDS is most prevalent. However, children are expected to roll over sometime between late first month and early fifth month (The Measure of Man and Woman, 2022, 12) This could force children into a bed change at the same time they are most vulnerable to SIDS.
Full-size cribs are often designed to hold children until they are 35” tall. This usually happens around the age of two. At two, the male is between 31.5 in. and 37 in. The average is 34.5 in. The female is between 31.25 in. and 36.5 in. The average is 34 in. At that same time interval, the male is between 23 lbs. and 34.5 lbs. The average is 28 lbs. The female is between 22 lbs. and 33 lbs. The average is 26.5 lbs.

The crib has the interior dimensions to hold a 35” child, and has the required 22” wall height to comply with CPSC regulations. Further testing of the mattress will be essential to ensuring it will be strong enough to hold a 35 pound child. The mattress must be designed for misuse as well. It is possible that two or more children might be in the crib at the same time, and probable that at some point the child will be jumping in the crib. The mattress must be able to stand up to these additional strains.
4.9.2 Parent data. It is essential that while bending at the waist, a parent be able to gently place a child in the bassinet or crib. Therefore, it is essential to understand the anthropometric data for the parent as well. Since height is the primary determining characteristic of whether a person could achieve this task, the measure of women were used because females are statistically shorter than males. The wall height of the proposed concept is at 37.5” from the ground. The waist height of the 50th percentile woman is approximately 40.3,” which is tall enough to bend over the wall. The waist height of the 1st percentile female is at 35.8,” which is not tall enough to bend over the wall. This means that a shorter-than-average woman would have difficulty placing a child in this concept.
Another important characteristic determining whether a woman could comfortably place a child in the crib is arm length. The CPSC requires 22” wall height in full-size cribs, and has now banned the use of drop-sides which were helpful in the past. Without being able to lower the sides, the parent would need an arm length of approximately 22” to reach the mattress.

A 50\textsuperscript{th} percentile female measures 22.4” from the pivot of the arm to the middle of the palm. This is barely long enough to reach the mattress. A 1\textsuperscript{st} percentile female has an arm length of 20” from the pivot of the arm to the middle of the palm. This is not nearly long enough to reach the mattress. Short individuals would probably have to stand on the tips of their toes to be able to set the child down in the crib. It is also important to remember that when held, a baby
do not lie flat as a board; its bottom can be lowered to the surface first, and then its head can be gently laid down afterwards.

![Anthropometric Data](image)

**Figure 4.18.** Female anthropometric data focusing on length of reach (Henry Dreyfuss Associates, 2002, p. 25).

The question remains as to whether this crib/bassinet concept is most effectively utilizing the space that it inhabits. The scooped sides of the crib are aesthetically pleasing, and were designed to raise the floor of the mattress so that the parent would not have to bend over as far. However, raising the floor inherently raises the height of the side of the crib, because of the 22” crib wall CPSC regulations.

**4.10 Full-scale Model**

A full-scale model of the infant bed was made out of pink foam insulation. By exporting the computer files to a Computer Numerically Controlled (CNC) router, the time to build the model was drastically reduced. The router works by removing material via a high-speed rotating cutting bit. The entire cutting process took approximately 70 hours of cutting time on the CNC router, but it allowed for accuracy typically unachievable by hand-formed foam.
Figure 4.19 shows a snapshot of the process. The pink foam insulation board has had material removed from one side, and is about to be flipped over so the machine can remove material from the other side. After all the parts were cut out, they were laminated together using 3M™ Super 77™ Multipurpose Adhesive.

To expedite the cutting time, the step-over of the drill bit was increased to its maximum allowed amount of 50%. This saved time while cutting, but left a rather rough, finish on the foam parts. This required additional sanding, and for the rough areas to be filled with spackling paste before painting.
Figure 4.20. Filling the imperfections with spackling paste. The 5’7” male also gives a sense of scale to the crib.

4.11 Master of Fine Arts Exhibition

The refined model was displayed at the Krannert Art Museum on the campus of the University of Illinois at Urbana-Champaign from April 16 – May 1, 2011. The model was built in two halves. One half showed the bassinet side up and the other half showed the crib side up. Snapshots of the design process were displayed on a 16” x 144” board above the models. The purpose of these images is to educate the audience about how the research led the designer to the conceptual outcome.
4.12 Proposed Alternatives

The purpose of building the full-scale model was to understand how people interact with the proposed solution. The most noticeable issue with the crib was its height. It felt uncomfortably tall. While, there are inherent problems with trying to stack a 22” crib on a 10” bassinet, there are ways to lower the height of the crib.

One alternative, as seen in Figure 4.22, is to remove the scooped sides on the bassinet half of the crib. This could reduce the wall height by three inches from 37.5” to 34.5.” While this change would make it easier for shorter individuals to use the crib, it also lowers the mattress height from ground level. This means the parent would have to bend over further to set a child in the crib.
4.13 Focus Group Testing

During the initial telephone conversation with Eileen Carlins from Cribs for Kids she offered to assemble a focus group of new and expectant parents once the full-scale model was complete. The next step in the design process is to take the crib to Pittsburgh, Pennsylvania to participate in this focus group. It will be interesting to see how people interact with the crib, and whether or not they are comfortable with the height. Most importantly will be to understand if they are comfortable with the idea of putting their child to sleep on a suspended mesh mattress. It is possible that people will be hesitant to trust in the strength of the material. This focus group is expected to occur sometime in May of 2011.
Chapter 5

Findings

The design process for this product is ongoing. Specifically the designer has still to identify a material that can perform all of the functions needed to support the infant and keep the infant safe. More research will have to go into this area and collaboration will most likely need to occur between the designer and material engineers.

Despite the failure to discover the proper materials necessary to implement this concept, the designer has been able to identify the key characteristics of the material. By researching the problem of Sudden Unexpected Infant Death, the designer has learned about the psychological and socioeconomical aspects of SIDS and ASSB. That research led to design insights, which in turn become design concepts.

The triangulation approach to understanding how parents and children interact with the crib has helped the designer reach a more appropriate design solution than through traditional research alone. The combination of interviews, observations, and empathic modeling techniques helped the designer understand the authentic human behavior associated with caring for a child.

While it was difficult to replicate the feelings associated with parenting at night, the empathic modeling allowed the designer to interact with the crib at a time when the parent is sleep deprived. Understanding how sleep deprivation can impair the ability to make safe decisions led to additional design insights, such as deciding against a co-sleeper crib, and seeking additional ways for the infant to sleep more soundly. The more time the infant is sleeping soundly, the more time the parents are sleeping soundly.
Some of the interviews, observations, and empathic design research centered around creating a baby bed that easily collapsed for traveling. Unfortunately, time restraints only allowed the designer to focus on the mattress and the stationary crib. Early conceptual sketches and models have been done to test the validity of a folding concept, but a refined solution for a collapsible crib is still in the early stages of conceptualization.

*Figure 5.1. Conceptual sketches for a folding crib.*

It will be important for the designer to both complete the stationary crib and the collapsible crib. As Eileen Carlins pointed out, Cribs for Kids distributes the Graco Pack n’ Play because the low-income families that receive the cribs often do not have enough room in their homes or apartments for a full-size crib. To make the most impact in terms of child safety, creating a collapsible version is essential.
Chapter 6

Conclusion

While the product is still in development, the design process which has led the designer to the concepts has been satisfying. The designer entered the process with a typical designer’s skill set, including sketching, model-making, and Computer-Aided Design (CAD) skills. The designer has exited the process with a more refined skill set, including tuned interview, observation, and empathic design modeling skills.

This thesis was also an opportunity to solve a relevant design problem. Although Sudden Unexpected Infant Death happens to less than one in every thousand live births in this country, the death of a newborn can be especially traumatic for the parents or the caretakers responsible for the child’s safety. Design can play a role in keeping these deaths from happening. It is clear from this design process that the path to creating a safer crib is long and challenging, however it is a path worth taking.
References


Suzy and Justin Lowman Interview Transcript, July 10, 2010

Interviewer: Those things, they’re called co-sleepers, aren’t they?

Suzy: Yeah, it’s um, the best way to describe it is they’re like a sidecar and it has three sides and it’ll make the mattress the level of the parents’ mattress. And then, the important thing is that it has attachments under it that hook under the parents’ mattress so it can’t slide away. Because, you can do that with our crib, you could, actually, when she was really little and I was nursing her a lot at nighttime, I actually did push the crib flush to the bed, but I never took that fourth side down because then it wouldn’t be safe because she could push back or fall between. So, these sidecars, I think they’re actually a little smaller than an average crib and then there’s a part that somehow attaches to the mattress to keep it from sliding.

Interviewer: I’ve been doing some reading, and they were talking about how, like, in 2001 or something, there was this huge public campaign saying that if you breastfeed your baby, they’re less likely to have SIDS.

Suzy: Yeah, they still say that.

Interviewer: And so, these things that go on the bed, it makes it a lot easier to do that. But yet, it stops people from actually having the baby sleeping…

Suzy: Yeah, actually sleeping, yeah. And they do make some, our friends Steve and Kari in Michigan, now they didn’t have a sidecar, but they supposedly make these type of bassinet things which you can put in the middle of the bed to sleep between both parents, so that the baby can’t roll anywhere, you know, too close to the parents but they’re still there. Now, I think that’s still, that to me is a little
dicey. I don’t know, the sidecar seems like the perfect combination, cause like I said, we kindof believe this, we choose to believe that, actually Ruby is still in the room with us in her crib, partially because, you know, we still need to work on getting her with Sienna, and Sienna is so small. But, I don’t know, it was just convenient for nursing, but then also with the research we heard how good it is to have them close. Like, somehow, the parents’ breathing wakes them up too a little bit.

Interviewer: That’s what I’ve heard. I talked to a woman who, I think she co-founded Cribs for Kids, which is parts of SIDS of Pennsylvania, and what they do is they give cribs to parents who don’t have enough money for a safe crib. And the research has shown that the safest place for a baby to sleep is in their own crib in the same room with the parents.

Suzy: See, that’s what we think too. That’s how, yeah, we felt comfortable with that scenario the best. And um, I don’t know, it’s interesting, there’s all these pros and cons no matter which way you do it. I don’t know necessary if it’s the crib design or if it’s just the closest the closeness to the parent that’s the most important thing.

Justin: I think those baby monitors now, put a pad under the mattress, and they can tell if the baby stops breathing…

Interviewer: I looked into those a little. I read some conflicting things about them. It basically said that if the baby did stop breathing, chances are, you’re not going to be able to do anything about it in time…
Suzy: You know what, I think that’s actually a really common occurrence from what I hear, like babies, they are so immature in their system, that I think it’s a certain subset of babies that do have an innate problem with them, that they can’t wake. But a lot of babies from what I’ve read, they do that normally, but most of them, they can turn their heads or arouse themselves, or if the parent is there. I almost wonder if there is a little biological part to it.

Interviewer: I did a lot of reading about it and it seems that there’s something in the brainstem that makes you less likely to wake up.

Suzy: That’s what I heard too.

Interviewer: Like, basically, they don’t know that they’re suffocating, and so they just don’t wake up.

Suzy: They’re in that deep of a sleep or something. Well, I think that’s the whole thing with nursing, too, I think that’s the number one reason why they say nursing helps, because when you nurse a baby, the baby is just going to wake up, naturally more during the night, which is such a pain. Um, and then, that’s actually why with Sienna, and now with Ruby, Ruby still wakes up once a night. And I’m ok with it. I’m kinda tired of it now because I am pregnant. It’s really close to morning, so it’s not a big deal, but they do that for a long time, they wake themselves up at night. And so, it kickstarts their breathing. I think that’s why they say that’s the safest way to…

Interviewer: That seems to be the inherent problem with the whole SIDS thing is that babies sleep better on their stomachs and they don’t wake up as often and the parents get
more sleep, but it’s safer for the baby to sleep on their back. And so, I think you gotta…

Suzy: They told people stomach sleeping for such a long time, you know. I don’t know, things change all the time with what they tell you to do, and you have to keep up with it. When you have a little baby home from the hospital for the first time, and they’re used being in this little ball, like you can see how…and Sienna had acid-reflux when she was a kid, and actually, she just really couldn’t sleep on her back, because it would come up all the time, so she slept on her belly very early, actually. We just took that risk because we knew she’d wake up to nurse and stuff. So there’s always lots of scenarios like that, you need to try not to feel guilty.

Interviewer: When the baby has reflux like that, do they need to sleep at an angle?

Suzy: You can get a wedge, like a foam wedge, that comes with these two things on either side, that’s supposed to keep them on it. That’s the main thing, but I think a lot of SIDS people are like “don’t even do it, because you don’t want to risk them rolling. So, another thing you can do is, like when a baby has a cold or whatever, is stick a pillow under the mattress, to just make the whole thing go like that. (Makes arm motions at an angle) That’s probably safer. We’ve done that with her. But what helped best, was just her sleeping on her belly with it. It’s kind of like when you have a bad cold and when you wake up you have all this acid back there, whatever, it’s gross. So, she was a restless sleeper anyways, so it worked out. Ruby doesn’t have that.
Interviewer: From what I’ve been reading, these articles written by the SIDS people, the way they write it is, if the baby has acid reflux, that they’re still more likely to choke on it, if they’re on their stomachs rather than on their backs. It’s the way they write it, but I mean, I…

Suzy: But she was more comfortable like that. We tried putting her to sleep in her car seat because we felt bad. We felt the car sleep was an incline, but then they came out saying that if the baby’s head goes for too long in a certain position in the car seat, they could have a SIDS situation.

Interviewer: It does seem like the kind of thing where they change their minds all the time on what’s safe and what isn’t, you know? I mean, we all slept on our stomachs, right?

Suzy: Yeah, I did. We did. Justin actually, now his mom was like my friend Kari, they used to sleep with her until they were like two. People do that all the time, I think that’s more common than people think…

Interviewer: You’re talking about the co-sleeping?

Suzy: Yeah, co-sleep, like straight up, in the bed, like without a sidecar or anything…

Interviewer: It seems so dangerous. Like the idea of having the baby sleeping…

Suzy: Well…

Interviewer: Maybe when they’re really young, but when they’re older, when they can take care of themselves…

Suzy: Well, I’ve been uncomfortable with it too, but, if you talk to people that are really for it like my friend Kari, and I’ve been to nursing groups and stuff, where people, like that’s a really typical thing people do because it’s easier because mom
doesn’t need to get up in the middle of the night and like physically be awake and feed the baby and whatever. But, they are so opposed to that part of SIDS research and say “it’s been done since the dawn of time, like a mother naturally knows, um, to wake up in response, like, there’s a sense like if the baby’s in a position that…As long as you’re not on drugs or alcohol or anything, that’s the whole key, you can’t do any of that. Then, I mean, in other cultures they do that all the time, and they talk about this all the time, and to me, to us, it’s not something we’re comfortable with, but a lot of people they really believe that.

Interviewer: And I’ve been doing some reading that, like, people in the Pacific Islands and stuff, they have like the lowest rates of SIDS there, and they all sleep with the parents there.

Suzy: It’s a safety issue. Like, they don’t want them to get eaten by a wild animal. You know, you hear that. I heard something, like, in Haiti, which totally breaks my heart, the babies have to sleep with their moms so they don’t get eaten by rats.

Interviewer: By rats! My gosh.

Suzy: Yeah, by rats. Like, in their ghettos. It’s a really scary problem, so people have to do it. And, their babies are fine. I don’t know. There’s so many factors to it. It’s always important to feel like you’re doing the right thing about it.

Interviewer: Did Sienna and Ruby sleep in a bassinet when they were first born?

Suzy: We have a Pack ‘n Play that’s a little smaller and it’s kind of like a play pen and you raise it up, and it kind of works like a bassinet, but it’s like a bigger space. But they couldn’t be in there very long, because the Pack ‘n Plays, and other bassinets, they usually only go up to ten pounds. And your baby gets to ten
pounds so fast. So, by then they need to be in a crib. What’d kind of interesting though, that we discovered about bassinets, over Pack ‘n Plays, is if you truly want to get them to sleep on their own when you first bring them home, it’s almost as if the crib is too big, like the extent that the space is though, cause kids are used to sleeping a ball and stuff. I think they feel more secure in like a bassinet or something, but like I said, it just doesn’t last very long. It’s a useful thing, but you grow out of it so fast.

Interviewer: I heard something about that, that a lot of mothers don’t want to put their babies in a big crib because the baby just looks so lonely in the middle of it.

Suzy: Maybe it’s like an emotional thing a little bit. I thought Sienna especially, could kinda sense, like “whoa” this is a different big space, and I think that’s why a lot of people swaddle their babies too, so they feel all small still, and everything.

Interviewer: But when I called up SIDS of Pennsylvania, to talk to that woman, she told me that the crib that they give to everybody is a Graco Pack ‘n Play, and they like that it has the bassinet feature on top of it so the baby is up higher.

Suzy: Yeah, that’s helpful at first. But, um, another thing too then, is they outgrow the bassinet at ten pounds, Sienna managed to put a nice dent into it too. (Laughs) Because she grew so fast, but then the mattress itself, I wish it was more comfortable. Like, it’s very lumpy, so I mean it lasts for a long time, like, I don’t know, Sienna probably could have slept in it until she was like, even close to 18 months, and it probably would have been relatively safe, but it just seems really uncomfortable. So, it’s almost like you feel bad if you don’t switch them to a crib.
Interviewer: They kind of look like a play pen to me. Like it looks like…

Suzy: Yeah, we’ve been trying to use that in the basement…

Interviewer: Is it still down there? I’d like to check it out because I’ve never seen one…

Suzy: If you want to see the other part of it, there is a changing feature, which a lot of people like about it too. It’s in the closet over here. It attaches to the top when you use it as a bassinet.

Interviewer: Suzy, I didn’t have the camera on before, when you were talking about putting the kids deep down in the crib without the drop down rails. Would you be able to say that again?

Suzy: I’m trying to remember my quote. Let’s see, how I feel about that is, well, right now especially, with being pregnant and having to lower Ruby in…if I wasn’t I think it would still be an issue, like it would still be hard to, you know, when I put Ruby in, she’s not quite asleep, and I think that’s what most people try to do to get them to sleep on their own. They’re not quite asleep, but they’re relaxed, and you want to put them in, but with the mattress being so low, it’s more of a challenge. And now especially, even being a little bit pregnant, it’s like I don’t think I could do it on my own. I’d have to have Justin do it because it’s just, you know, it just hits you at a funny spot. And she’s not happy and I’m not happy. So, yeah, if it didn’t have that dropdown side…and we make sure the hardware and everything is fine on it. We’re comfortable with it. Probably, if we didn’t have that dropdown side, part of us would be tempted to leave that mattress up a little higher but then it wouldn’t be safe. And then they could just fall out, outright fall out when she tries to push herself up.
Interviewer: I wonder what they’re going to do to change that, you know, with cribs, with the dropdown sides.

Suzy: You figure, I guess, they never had dropdown sides forever. And probably, your grandma, when she put all her babies to bed, she managed. It’s very convenient and we just make sure it works right all the time.

Justin: One thing about SIDS is, I don’t know where I read it or what studies they used, but since the whole campaign for babies to sleep on their back, they like to say that SIDS has decreased in that time span, but really, it’s only decreased by like half a percentage point.

Suzy: Probably in one of our parent magazines.

Justin: At the same time though, in the same time period, people have been better informed about the effects of, you know, drinking alcohol or doing any kind of drugs while you’re pregnant, so I mean, it could be because they’re telling people to sleep on their back or it could be for any reason. It’s like most studies, you can get what you want out of it.

Interviewer: It is interesting. From what I had read, since 1992, SIDS has gone down like 50%, so it’s like halved.

Suzy: They skew stuff sometimes. I wonder what the whole…

Interviewer: Yeah, I think it’s down to like 2500 a year, from around 5000.

Justin: Oh, really. Ok. Yeah, I don’t remember.

Interviewer: But still, 2500 is still a lot of babies. And, you know, it’s one of those things where, you can’t stop all of them from happening, plenty of, I mean, everybody dies of natural causes at some point.
Justin: Yeah, like they said, it could be something in the brain, you know, doesn’t quite work as it should, so they don’t wake up.

Suzy: I think there’s a truth to that. Oh, another thing I heard too, is um, babies are less likely to have a SIDS situation if a fan is on in the room when they sleep.

Interviewer: Could be.

Suzy: I have the ceiling fan on with Ruby, or actually, we always leave a box fan on, for the girls, to block out noise, and I think, well gee this helping with the air circulation.

Interviewer: I think the most important thing is not having, like, not having a soft pillow or a soft blanket, when they’re real young, something a baby could suffocate in. I think that’s the most important thing.

Justin: Yeah, you’re not supposed to put the crib pads in until a little later.
Appendix B

Empathic Design Research Journal

September 28, 2010

I set up the playard tonight. It was very easy. It took me less than three minutes. I put it in the corner of the room where I should not trip over it. I had to rearrange some things in my room to make it fit, which makes the room look a little unorganized, but that is ok. I turned off the lights to see how dark the room is. Maybe my eyes just weren’t adjusting quickly enough, but I could barely see the crib, even with two night lights on. I might need to leave the light on in the bathroom and crack the door so that I can see the crib.

I am getting anxious about starting this empathic modeling. I am already stressed and tired, and breaking up my sleep is going to make things harder on me. I am nervous to find out how patient I am. I am also nervous about this new sleep pattern. I am going to bed earlier than usual and waking up earlier. I know that I need to sleep though, or I will be so tired in the morning.

I am feeling: ANXIOUS

September 29, 2010

At 2 am I woke up to the sound of a crying baby. The first thing I remember is that I was able to see everything in the bedroom. My eyes were completely adjusted. I remember being tired, angry, confused, and frustrated. I would be more patient if this was a real baby I think. It’s hard to replicate the connection between a parent and his child. I turned off the baby sound and carried the infant around for 10 minutes.
Turning the light on after being asleep is terrible. Not only did it hurt my eyes, but it started to wake me up. Of course, I didn’t want to wake up, because I wanted to fall back to sleep as soon as possible after taking care of the baby.

I am feeling: HOPELESS

At 5 am the baby cried again and for some reason, even though I was tired, I felt empathetic for both the baby and parents who do this every night. The baby does not have any means of communication other than crying, and when they are scared or uncomfortable, it’s the only way they can get help. The parents who do this every night are amazing. It takes so much out of me.

Turning on the light to take my picture is killing me. I need to find a better way to do this. If the baby is just crabby, I could soothe her back to sleep, but if a diaper needed to be changed, I would need the light on to do it.

I am feeling: UNDERSTANDING

I woke at 6:30 this morning. I was so exhausted that I hit snooze four times before I woke up. My cell phone alarm was on the other side of the room, so I actually got out of bed four times to shut it off and go back to sleep.

I am feeling: EXHAUSTED

In Junior Design Studio the students were presenting their prototypes and renderings, but I yawned through everyone’s presentations. I was exhausted to the point that it gave me a headache and nausea. Eventually I just needed to give the class a five minute break so I could go outside and get some fresh air, followed by a drink of water. Luckily, my 1pm class was cancelled so my day was over. I don’t know how I would have made it through.

I went home for lunch and then got back to work. (While drinking a pot of coffee)
11pm – I decided to sleep earlier tonight and set my alarm later. Unfortunately, the neighbors were having a party, and it was loud. I didn’t get to sleep until 1 am. I feel more prepared today, because I have decided that when I wake up to help the baby, I will not turn the light on immediately. Instead, I will turn the light on in the bathroom, and crack the door so that I am acclimated to the light over time. Hopefully this does not make the light feel as harsh.

I am feeling: READY

September 30, 2010

I wasn’t sleeping very well when the baby started crying at 2 am. I am not sure if this is why I was calmer when I woke up, or if I am just getting used to having a baby in the house. I am starting to change my outlook on this experiment. On the first night, I was angry and frustrated, but now I am starting to understand that this is the only way that the baby can communicate. I think I am better prepared for this since my mother has done child care at home since I was born. The sound of a baby crying does not bother me much.

I am feeling: CALM

5 am – I was still calm when I woke up at 5 am. I think the reality is starting to set in that the baby is not going away anytime soon. There’s no point in being angry because it’s not going to help the situation. This is the way that my life is going to be for the next six days. Raising the ambient lighting incrementally has really helped. My eyes feel much better. I am also beginning to realize that the ten minutes I have been staying awake with the baby is starting to feel like less and less time.

I am feeling: RESIGNED
When I woke up at 8 am this morning, I felt much better than I did the previous morning. I think partly it is because I slept longer, but also because I have grown accustomed to having the baby in the room.

**I am feeling: BETTER**

Tonight I have a meeting for Graphic Design Laboratory at 8 pm. I am nervous about this meeting because I put the baby to bed at 8 pm. Either I am going to have to find a babysitter or I am going to have to take the baby with me. I don’t feel like taking the baby with me is a viable option because I should not disrupt the baby’s sleep cycle.

I decided that the best course of action is to get a baby sitter for the hour meeting. Therefore, I am leaving the baby at home during the meeting. This of course would be an added expense to the parents, but it allows the child to sleep better.

I am – As I fall asleep tonight, I can’t help but feel depressed. These feelings aren’t all connected with the baby; most come from my personal life. However, I know that the infant isn’t going to let up. She doesn’t know that I had a bad day, or that I am exhausted, or that I am feeling down. She is still going to wake up twice tonight, which in turn is going to wake me up twice.

Since I live alone, by experience is more similar to a single parent than a dual-parent household. There is no sharing of the nighttime responsibilities. It is my job to take care of everything. Even in dual-parent households, if a mother chooses to breastfeed instead of using formula, she would have to do most of nighttime care. The father can change diapers or help soothe the baby back to sleep, but he can’t produce milk. I imagine this is why some mothers decide to co-sleep or use a “co-sleeper” crib. This way, they don’t necessarily need to be awake while the infant is nursing.
I am feeling: **DEPRESSED**

2 am – I have been asleep a little less than an hour, but it feels like it has been a couple of minutes. Unfortunately, the sleep hasn’t made me feel any better, as I am still in a terrible mood. I try to think that baby isn’t trying to intentionally make my life miserable, but it doesn’t make me feel any better. I walk the baby around for ten minutes then fall back to sleep.

I am feeling: **ANGER**

5 am - For some reason, I am having a terrible time staying awake with the baby right now. I know that it is only for ten minutes, but my brain keeps telling me that I should just lay down with the baby in the bed with me. I could go back to sleep and leave her next to me. Then I could understand what it would be like to co-sleep. Would I roll over on her in the middle of the night? I decide that even though she isn’t real, I still wouldn’t chance it. I put her back to bed in crib and lay back down after only 8 minutes. I couldn’t stay awake any longer.

I am feeling: **UPSET**

8 am – I feel terrible. I feel like I slept for only three hours, except for I know I actually slept for seven. I don’t have time to go back to sleep though. I need to teach at 9 am. Normally, I like to walk to class in the morning, but because I am moving so slow this morning, I had to drive. This costs me more money since I had to pay for the meter. At least I wasn’t late for class though.

I am feeling: **CRABBY**

I made it through the day without a problem. Once class started, I woke up and felt much better. My Friday is longer than normal, because I have an extra class to teach today, along with an additional meeting.
Once I get back home, it starts to set in that it’s just me and the baby this weekend. It’s the first weekend in a month that I am going to be staying in Champaign and I don’t have any plans. It is going to be a long weekend of homework and broken sleep. I am anxious about how tonight is going to work. Normally she only wakes me up twice, since I have to wake up for school by the time she wakes up a third time. However, if I decided to sleep in at all tomorrow, I will have to wake up a third time to care for her. Also, if I go to the Japan House open house at 10 am or the Illini football game at noon, I will have to take her with me.

I am feeling: TRAPPED

2 am - The baby was crying for a full three minutes before I woke up. I was just so tired that I slept right through it. The first thing I thought of was that I didn’t pack a diaper bag for tomorrow, and didn’t know how I was going to get the crib, baby, and diaper bag to the babysitter before I go to the 11 am Illini football game. I was concerned that I would not have enough time to get ready in the morning. I have never been here on a football weekend before, so I have no idea how crazy traffic is.

I am feeling: UNPREPARED

5 am - Just like last night, I had a terrible time staying awake at 5 am. There are times where I wake up and care for the baby as if it was alive, and other times I am too tired to care. This was the latter. As tough as it is to wake up with the baby twice a night, it would be much harder in real life. I think one of the downfalls of empathic research is that in the back of my mind, I know that I can leave this make-believe world behind whenever I want.

I am feeling: INDIFFERENT

I woke up on Saturday excited about the weekend and getting to the football game. However, I did not have enough time to get the baby ready. I had to leave her here
instead of taking her to the “babysitter” like I wanted. I had planned on taking the crib and a diaper bag to the studio. I felt guilty about leaving her here, and I know if this was reality it would cost me a lot of money to hire a babysitter to watch the baby here. If I was poor, there’s no way I would be able to afford the babysitter, and of course I couldn’t leave the infant home alone.

I am feeling: EXCITED

October 3, 2010

Midnight – I am in a decent mood because Notre Dame won its football game tonight, but I am also completely exhausted. I walked over 5 miles today to the Illini football game, and then to Japan House and back. I wish I could sleep in tomorrow, but I know that I have a lot to do. I plan on spending a lot of time at the studio and I will take the baby with me. There’s not much else that I am thinking about right now other than what I need to get done for school tomorrow.

I am feeling: PREOCCUPIED

2 am – I stumbled around the room, trying to turn off the alarm. It’s unsettling waking up in the middle of the night. I often don’t know what time it is or even what day it is. I had trouble falling back to sleep.

I am feeling: DISORIENTED

5 am – I felt indifferent when I woke up at 5 am again. I wasn’t able to stay awake for the full 10 minutes. I am starting to think that I have learned enough from this nighttime empathic research and should move onto more experiences where I take the portable crib from place to place.

I am feeling: INDIFFERENT
10 am – I slept in a little bit today and feel prepared for the day ahead. I have a lot to do and need to get started if I am going to get it all done. I probably need to spend 12 hours on homework today if I am going to be where I expect to be.

**I am feeling: RESTED**

11:30 pm - Instead of going to the studio today like I planned, I stayed at home instead. I feel pretty good because I got a lot done today. Tomorrow I plan on putting some lead shot into the baby to get it to a proper weight. Also, I want to buy a used car seat from someone in the city. I want to recreate the experience of carrying the baby, a diaper bag, the crib, and the car seat to and from the car.

**I am feeling: PREPARED**

October 4, 2010

2 am – It’s really hard waking up at 2 am. I had only been sleeping for an hour when the alarm rang. I need to do more research on adult sleeping patterns, because think there is a sleep pattern issue about why it is harder to wake up after sleeping one hour than it is to wake up after sleeping for two hours.

**I am feeling: EXHAUSTED**

5 am – I once again was unmotivated when I woke up at 5 am. It is just so tough and I still think that I would be more patient if this was a real baby. It’s hard to get into character when I get out of bed at 5 am.

**I am feeling: CRABBY**

9:03 am – I woke up this morning in a panic because there wasn’t an alarm ringing. It’s because I had overslept. I teach the Junior Design Studio starting at 9, and ended up being a half hour late, even though I didn’t even shower. I have absolutely no recognition of turning my
alarm off, but I imagine I just grew numb to having an alarm wake me up every three hours. I was embarrassed walking into class late and blaming it on my baby keeping me up all night.

I am feeling: LATE

11 pm – Today I bought some Morton Rust Remover Salt Pellets and used them to add weight to the baby. I put on my Cleveland Clinic shirt and cut her open, pulled out some foam, and filled her with salt pellets. I do not have a scale here, so I do not know how much she weighs exactly, but it feels right, although lumpy. I am still finishing up some homework here. It might be a long night.

I am feeling: STRESSED

2 am – I was still up doing homework at 2 am. This is the first time that I held the baby for any length of time with the added weight. It definitely gets tiring, but this baby is still small and weighs less than 10 lbs. If it was a 25 lb. baby, it would be a different story. I have already been having some neck and back problems, from leaning over my laptop screen. It doesn’t matter to the baby though. She still needs to be carried around.

I need to purchase some baby diapers. I think it would make the baby feel more realistic, plus I need to practice changing a dirty diaper in the middle of the night.

I am feeling: STRESSED

5 am – This is the last time that I am waking up for the baby. It is the end of the 7th night. I feel relieved, but I am really too tired to appreciate it right now. It will probably hit me when I get to sleep all the way through tomorrow night.

I am feeling: DONE

9 am – I am taking the baby to school with me today so I get the feeling of that it is like to carry and all the baby necessities around. I had to wake up almost an hour early so that I
could still make it to my 10 am meeting on time. It was my first time disassembling the portable crib. I was a little confused about the disassembly process. I started by trying to unlatch the portable sides first, but the mattress needs to be pulled out before, followed by collapsing the floor. Then the sides unlatch. I also was looking for the bag that it came in, but it didn’t take me very long to realize that it gets wrapped up in the mattress, which has Velcro straps. There is a drawstring bag, but I think it’s in my trunk. I didn’t need it for transportation though.

I packed a diaper bag with baby blankets, a bottle, diaper rash ointment, a diaper-changing mat, a bib, and a roll of paper towels (to simulate the space taken up by diapers). I also needed to carry my laptop backpack, the crib, and the baby. The first thing I noticed is that it takes a lot of planning just to get out of the house. I needed to think about what order I picked up the items and set them down. I put the backpack on first because it still allowed me the full use of both my arms. Then I picked up the diaper bag and put the strap around my neck. This was not as easy, since the backpack already occupied some of the area where the bag naturally wanted to go. Then I picked up the baby, and shuffled her to my right arm. Last I picked up the crib in my left arm. Unfortunately, I was only able to walk a few feet to the door before setting the crib down so I could open the door. I also had to set it down to lock the door. I had the keys in my hoodie pocket so they were easier to get to. Then I walked to the elevator, set the bag down again to press the button, picked it up, walked into the elevator, set it down, pressed the button, and picked it up again.

When I go to the car I set the crib down, popped the trunk and unlocked the car with the key fob. I placed the diaper bag and crib in the car, walked to the side, and put the baby in the car seat. I then put my backpack into the back seat as well. I was already starting to sweat, and I hadn’t even gotten her into the studio yet.
I asked Shuo to record me once I got to the studio. Then I popped the trunk and opened the side door, put my backpack on, took her out of the car seat, walked back to the trunk, and picked up the diaper bag and the crib. I set the crib down and closed the trunk, picked it back up, fed the meter, and walked to the studio. I had to set the crib down to open the first door and again at the second. At that point, I decided just to leave it there until I dropped the rest of the stuff off at the studio. I asked Shuo to hold the baby while I set my stuff down and went back for the crib. He also needed to hold her while I set the crib up. It took me less than a minute to set up though, and she was back in the crib again.

I think it is remarkable how easy the crib sets up and takes down. It is intuitive and even on the first try it is simple and fool-proof. The problem with this crib though, is that the floor is so low to ground that it is difficult to place the baby in it. I am young and healthy too. If I had reoccurring back problems, was pregnant, or was disabled this would be more difficult. This is the advantage of full-size cribs with drop-down sides. They place the baby at a much more comfortable height for lifting.