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Title of Dissertation: Educating Caregivers about Infant Positioning and Improving Infant Intolerance of Tummy Time

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ABSTRACT

Title of Document: **EDUCATING CAREGIVERS ABOUT INFANT POSITIONING AND IMPROVING INFANT INTOLERANCE OF TUMMY TIME**

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Each year in the United States, approximately 3,500 infants die suddenly and unexpectedly (Centers for Disease Control, 2018). The number of infant deaths has declined sharply since the early 1990s when the American Academy of Pediatrics (AAP) recommended that caregivers place infants in the supine position (i.e., on their backs) for sleep. As a part of the recommendations to place infants on their backs for sleep, the AAP also recommended that infants be placed in prone (positioned on their stomachs) for play, known as "tummy time." Lack of tummy time has been associated with developmental delays and head deformation (e.g., Davis, Moon, Sachs, & Ottolini, 1998; Graham, Kreutzman, et al., 2005). Of caregivers who report awareness of these recommendations, a number of caregivers report barriers to implementing these recommendations, such as infant intolerance of the position (e.g., Dudek-Shriber & Zelazny, 2007; Koren, Reece, D'angelo, & Mederios, 2010; Zachry & Kitzmann, 2011). Additionally, although infant intolerance of tummy time is frequently reported in the literature and the AAP has recommended interventions to improve tummy time (e.g., provision of toys), very limited research has been conducted on the efficacy of these recommended interventions. To

date, the study was the first to our knowledge to: (a) identify *expectant parents'* knowledge of the AAP positioning recommendations, (b) study the effectiveness of a video designed to educate caregivers of the AAP positioning recommendations for safe sleep *and* tummy time, and (c) evaluate the individual and combined effectiveness of toys and interaction on infants' negative vocalizations and head elevation during tummy time.

EDUCATING CAREGIVERS ABOUT INFANT POSITIONING AND IMPROVING INFANT INTOLERANCE OF TUMMY TIME

By

Amber E. Mendres-Smith

Dissertation submitted to the Faculty of the Graduate School of the University of Maryland, Baltimore County, in partial fulfillment of the requirements for the degree of Doctor of Philosophy, 2018

Dedication

To the three people who encouraged me since I was a little girl to always work hard and pursue my dreams: Dad, Mom, and Grandma, this is for you.

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Chapter 1: Introduction

Prior to the early 1990s, a majority of caregivers placed infants in the prone or "tummy" position to sleep (Jones, 2004). However, in 1992, the American Academy of Pediatrics (AAP) recommended that infants be placed on their backs in the supine position for sleep as a part of the "Back to Sleep Campaign" (now known as the "Safe to Sleep" Campaign). The AAP made this recommendation after identifying a correlation between the prone position and Sudden Infant Death Syndrome (SIDS). SIDS is defined as "the sudden death of an infant under 1 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"[1] (Willinger, James, & Catz, 1991, p. 681). Although researchers identified a correlation between the reduction in infant death and introduction of the Back to Sleep Campaign, SIDS continues to be the leading cause of infant death in the United States beyond the neonatal period (CDC, 2018[2]).

Shortly after the AAP's recommendation to place infants on their backs to sleep, pediatricians began to notice that infants were reaching gross motor milestones at later ages (Jantz, Blosser, & Fruechting, 1997). Specifically, compared to infants who slept in the prone position, researchers found that supine sleepers experienced delays in gross-

[1] The term "Sudden Unexpected Infant Death" (SUID) is the umbrella term that is now frequently used to describe SIDS *and* other unexpected deaths in infancy. Specifically, SUID includes SIDS (as defined above), death due to "unknown causes" (when one or more parts of the investigation are not completed), and "accidental suffocation and strangulation in bed" (which includes suffocation by soft bedding, overlay by another person, wedging or entrapment, and strangulation, such as between crib railings; CDC, 2018). When describing SIDS and SUID in describing the literature, the terms used in the manuscript will be those used by the authors in the described studies.

[2] SIDS was leading cause of infant death beyond the neonatal period in 2015, which as of January 2018, is the most recent year for which CDC has published available data.

motor milestones, such as rolling prone to supine, sitting "tripod," creeping, crawling, and pulling to stand (e.g., Davis et al., 1998; Jantz et al., 1997). Supine sleeping has also been associated with delays in other developmental domains, such as social development (e.g., smiling spontaneously; Dewey, Fleming, & Golding, 1998). Excessive supine positioning can also result in the development of muscle conditions and deformities, such as positional torticollis (an inability to turn head in one direction due to tightening of muscles) and plagiocephaly (asymmetry or flattening of the head), which can require surgery, the need for helmeting to reshape the head, or result in long-term cognitive delays (Hutchinson, Thompson, & Mitchell, 2003; Persing, James, Swanson, & Kattwinkel, 2003).

To compensate for the increased time infants should spend in the supine position for sleep and to help thwart the unintended consequences or complications of primarily supine positioning, the AAP (1996, 2000, 2005, 2008, 2016) recommended that infants spend supervised time in the prone position during waking hours to facilitate gross-motor development. The AAP (2008, 2017a) recommended that parents place their infants in prone "2 to 3 times a day for a short period of time (3-5 minutes), increasing the amount of time as the baby shows he enjoys the activity" (p. 2)[3] and that parents place themselves or a toy in front of the infant if the infant does not like the position (AAP, 2008, 2017a). Positioning in prone for play, known as "tummy time," has been associated with normative gross-motor development (e.g., Kuo, Liao, Chen, Hsieh, & Hwang, 2008; Salls

[3] In the 2016 policy update, the AAP noted that "there are no data to make specific recommendations as to how often it should be undertaken" but that, "a certain amount of prone positioning, or 'tummy time,' while the infant is awake and being observed is recommended" (p. 7) to prevent flattening of the heads and to facilitate gross-motor development.

et al., 2002), as the prone position strengthens the muscles infants need for head control, reaching, pulling up, and other milestones (Zachry & Kitzmann, 2011). The following review of the literature will offer a historical perspective to describe the benefits of tummy time, some gaps in the literature, and the need for the current research.

A Historical Overview of Sleep and Tummy-Time Recommendations

Sleep-position recommendations during the 20th century. In the early 1900s, the presumed medical cause of SIDS was accidental suffocation by intoxicated mothers (e.g., by overlying; Westcott, 1903). However, in the 1940s, as autopsies became more common, accidental suffocation by overlying became a less prominent presumed mechanism for infant death (Gilbert, Salanti, Harden, & See, 2005). Gilbert and colleagues note that in 1944, a pathologist in New York provided data on infant deaths by suffocation, which indicated that two-thirds of the infants were found in the prone position (Abramson, 1944). At the time, there was also supporting evidence about the possible risks associated with the prone position from deaths in the United Kingdom (Davison, 1945) and Australia (Bowden, 1950). Despite the evidence at the time, campaigns that advised against the prone-sleeping position were largely criticized. One such criticism by a pediatrician in favor of the prone sleeping position was that the prone suffocation hypothesis "instilled guilt and self-incrimination in parents" (Woolley, 1945). This same pediatrician, Woolley, conducted research with infants in which he covered their faces with blankets and measured the content of the air the infants breathed. Woolley concluded that the oxygen content was only a concern if the blanket material was not permeable material (e.g., a rubber sheet). Woolley also noted that the infants would move if breathing were obstructed, which seemingly discredited the hypothesis

that prone sleeping or blankets were associated with SIDS. As noted in Gilbert and colleagues' historical review of sleeping recommendations, additional explanations for death also emerged at the time, such as asphyxiation on vomit (Polson & Price, 1948) and hypersensitivity to milk (Camps, Parish, Barrett, Coombs, & Gunther, 1960). Woolley's study and such explanations weakened the hypotheses that prone sleeping was a principle cause of SIDS, and from 1943 until 1988, the prone position was the recommended sleeping position in books and other texts on infant care (Gilbert et al., 2005). Gilbert and colleagues found that after 1988, no texts recommended that parents place infants in prone, rather, recommended that parents place infants on their sides or in the supine position for sleep.

It was not until 1992 that the AAP provided official recommendations for how infants should be positioned for sleep. After the prone sleeping position was recommended for 45 years, the AAP Task Force on Infant Positioning and SIDS (1992) conducted a meta-analysis of studies that examined SIDS deaths associated with the infant's "usual sleeping position," position when "last put down," and position of infant when "found dead." The studies the AAP examined that evaluated the infant's usual sleeping position included seven published studies that examined SIDS deaths between 1965 and 1990 in Ireland, the United Kingdom, Tasmania, Hong Kong, New Zealand, and the United States. Collectively, the seven studies examined included approximately 1,550 cases of SIDS and 4,600 controls. In reviewing the data, the AAP Task Force found a significant correlation between the prone sleeping position and SIDS. Specifically, in contrast to the usual sleeping position of control infants, the AAP Task Force identified that infants who were found dead were up to 12 times more likely to be

found in the prone position. More recently, Gilbert and colleagues (2005) conducted a meta-analysis of 40 studies published between 1965 and 2004 that reported data on sleeping position of infants who died from SIDS in the United States, Europe, and Australasia. Their meta-analysis identified a statistically higher risk of death associated with the prone position compared to the supine or non-prone position. Notably, in 1970—after only two case-control studies had been published on the position of infants who died from SIDS—there were already enough data to indicate there was a statistically significant risk of fatality associated with prone positioning compared to supine (Gilbert et al., 2005). That is, Gilbert and colleagues suggest that had the available data on SIDS risks been reviewed in 1970, at least 60,000 deaths could have been prevented in the United States, Europe, and Australasia.

The AAP Task Force safe-sleep recommendations. In 1992, the AAP published their aforementioned meta-analysis of studies that documented the sleeping position of infants who died from SIDS and laid out hypotheses regarding the mechanisms by which prone positioning could lead to infant death. In their review, the AAP noted the following as possible mechanisms:

> (a) Oropharyngeal obstruction: can occur when the jaw or jawbone is displaced, which can result in the infant's airway becoming obstructed; such obstruction is more likely when there is pressure on infant's face, such as when the infant is lying in prone (Mathew, Roberts, & Thach, 1982; Milner, Boon, Saunders, & Hopkins, 1980; Thach, & Stark, 1979; Tonkin, Stewart, & Withey, 1980).
>
> (b) Rebreathing air from pockets formed in bedding or from soft or porous sleeping surfaces: can occur when such soft materials trap air, which then leads to

the infant breathing air that lacks sufficient oxygen content (e.g., Kemp & Thach, 1991).

(c) Cervical hyperextension associated with prone positioning: can be caused when the neck (i.e., the area of cervical vertebrae located below the skull) is extended backward, which can decrease cerebral blood flow; such hyperextension is more common when the infant is prone (Saternus, Koebke, & von-Tamaska, 1986).

(d) Overheating: can be caused by elevated room temperature and/or excessive clothing on the infant; a theoretical model of heat imbalance also suggests a reduction in heat loss associated with contact between the surface area of the infant's body and head and the sleeping surface when in prone; these factors can contribute to hyperthermia (i.e., heatstroke) in an infant which is associated with reduction in blood pressure, dehydration, brain damage, and organ failure (Nelson, Taylor, & Weatherall, 1989; Ponsonby, Dwyer, Gibbons, Cochrane, & McCall, 1992).

After weighing the data at the time regarding the sleeping position of infants who died from SIDS and the possible mechanisms for death in the prone position, the AAP Task Force in 1992 concluded that,

> Although prospective randomized clinical trials have not been performed, the weight of evidence implicates the prone position as a significant risk factor for SIDS…After evaluation of all available evidence to date, for the well infant who was born at term and has no medical complications, the Academy recommends

that these infants be placed down for sleep on either their side or back (AAP, 1992, pp. 1124-1125).

In the 1992 policy statement, the AAP noted that exceptions to the non-prone sleeping position recommendation were: (a) premature infants with respiratory distress, as the prone position may be associated with improved oxygenation and pulmonary function for these infants[4], (b) infants with symptomatic gastroesophageal reflux, as prone positioning may be associated with less reflux, and (c) infants with certain craniofacial anomalies or other upper-airway obstructions.

Safe to Sleep Campaign. Beginning in 1994, the National Institute of Child Health and Human Development (NICHD) partnered with the AAP, the SIDS Alliance (now known as "First Candle"), the Maternal and Child Health Bureau of the Health Resources and Services Administration, and the Association of SIDS and Infant Mortality Programs to disseminate the 1992 AAP recommendation. This campaign to educate caregivers about safe sleep practices, currently known as the "Safe to Sleep Campaign" (formerly known as the "Back to Sleep Campaign"), has been associated with a 50% decrease in the incidence of SIDS (AAP, 2005). Other researchers have estimated that between 1993 and 1995, the SIDS rate decreased from 3.5 deaths per 1,000 live births to 0.2 per 1,000 live births, which represents a 94% decrease in SIDS deaths (Skadberg, Morild, & Markestad, 1998).

[4] In the 1996 policy update, the Task Force determined that the clinical benefits in terms of respiratory physiology of the prone position for these infants do not outweigh the risk of SIDS, and as such, they have removed preterm infants with respiratory disease as exceptions to the recommendation.

Over the years, the AAP has issued updates to the 1992 policy statement, including recommendations for altering the infant's environment to prevent SIDS. Such recommendations include avoiding (a) soft surfaces and other objects that will trap air (e.g., pillows, blankets, crib bumpers, stuffed animals), (b) cribs that do not conform to current safety standards, (c) bedsharing (i.e., sharing a bed or other sleeping surface with another individual) due to the risk of death by overlying, (d) smoking during pregnancy or after the infant is born, (e) sleeping devices claiming to reduce risk of rebreathing and that will maintain sleep position, and (f) overheating due to excessive clothing on infant (AAP, 1996, 2000, 2005, 2016). Additionally, in 2005 the AAP amended their position on side sleeping and recommended only supine sleeping, as there is a higher risk of SIDS associated with side sleeping as compared to the supine sleeping position. Appendix A presents the AAP safe-sleep recommendations and notes which 1992 recommendations were amended in the 1996, 2000, 2005, and 2016 policy statements.

The AAP tummy-time recommendations. Chiefly, perhaps most relevant to the proposed research is the AAP Task Force recommendation, beginning in 1996, which noted that, "A certain amount of 'tummy time,' while the infant is awake and observed, is recommended for developmental reasons and to help prevent flat spots on the occiput" (AAP, 1996, 2000). However, it was not until 2008 that the AAP provided any other information about tummy time—including the developmental benefits of tummy time, when to begin tummy time, and how often to conduct tummy time. In 2008, the AAP (in collaboration with Healthy Child Care America) published the "Back to Sleep, Tummy to Play" pamphlet for caregivers. It was in this pamphlet that the AAP provided a more concrete developmental rationale for tummy time and accompanying recommendations.

Specifically, the AAP noted in the pamphlet that tummy time is needed so that the infant can "develop strong muscles," and be prepared for "the time when they will be able to slide on their bellies and crawl."

Infant Development Associated with Positioning for Sleep and Play

Infant development associated with sleeping position. At the time of the safe-sleep recommendations, a number of studies—as previously described—reviewed the risks associated with prone positioning for sleep, but did not describe possible associations between gross-motor development and certain sleep positions. However, following the AAP supine sleeping recommendations, pediatricians noted a marked change in infants' gross-motor milestone attainment (e.g., Jantz et al., 1997; Salls, Silverman, & Gatty, 2002). To study this change, Jantz and colleagues (1997) conducted one of the earliest studies on sleep position and the attainment of motor milestones among infants. These researchers conducted a retrospective chart review of 257 infants to determine if parent-reported sleep position was associated with milestone attainment at the 4- and 6-month well-child visits using the Denver Developmental Screening Test-Revised (Frankenburg, Dodds, & Archer, 1992; see Appendix B for an overview of the assessment tools to be covered). At 4 months of age, infants who slept in supine or side-lying were less likely to roll when compared to infants who slept in the prone position. Pulling to sit with no head lag, grasping a rattle, and reaching for objects were not significantly different between the groups at 4 months. At 6 months, there were no significant differences between the groups on passing a cube from hand to hand or sitting upright and taking one cube from each hand. Although rolling over at 4 months was the only significant difference between the groups, the researchers suggested that the normal

age ranges for attainment of developmental milestones may need to be revised based on the infant's primary sleeping position.[5] Taking the results as a whole, this study suggests that rolling may be delayed for infants who sleep in the supine or side-lying position.

In contrast to Jantz and colleagues' (1997) retrospective study of sleep position and development, Davis et al. (1998) conducted a prospective study on the sleep position and milestone attainment of 351 infants. Davis and colleagues asked parents of the infants to record the average number of hours the infant spent in prone, supine, or side-lying position for the first week of life, then the amount of time spent in these positions each month for the first six months of life. In addition to completing a sleep log, the researchers asked parents to complete a developmental log that included 18 questions about motor skills, of which eight milestones were used for their analyses. The researchers also compared parent developmental logs to physicians' observations of the infants' development and, when parents' logs did not match the physicians' observations (for approximately 5% of the infants), the researchers used the physicians' observations for analysis. In other words, if a parent reported in the developmental log that the child was rolling at 5 months of age, but the physician did not observe this milestone, in the analysis the researchers used the physician's report that the milestone of rolling was not

[5] As noted by Jantz and colleagues (1997) and Majnemer and Barr (2005), developmental assessments may need to be re-normalized given recent data on milestone attainment of supine and prone sleepers. That is, researchers have assumed that normative assessment data obtained before 1994 (when the Back to Sleep Campaign was initiated) included infants who caregivers primarily placed in prone for sleep (Salls et al., 2002). Thus, the normative sample from assessments like the Denver Developmental Screening Test Revised (validated in 1988) and the Alberta Infant Motor Scale (validated between 1990 and 1992) are likely not representative of the population today, given the AAP recommendation for caregivers to place infants in supine for sleep. To date, there are not new normative data for the Denver Developmental Screening Test- Revised or the Alberta Infant Motor Scale.

attained at 5 months. Davis and colleagues found that infants who slept prone generally acquired milestones at an *earlier* age than those infants who slept supine. Specifically, there was a significant difference between prone and supine sleepers for the age at which infants began rolling to supine, sitting tripod, creeping (pulling self along with stomach touching floor), crawling, and pulling to stand. There was not a significant difference between prone and supine sleepers for rolling supine to prone, sitting unsupported, transferring objects, or walking. Infants whose parents reported variability in sleeping position or side sleeping reached milestones later than infants who slept prone but before infants who slept supine. However, the researchers noted they did not include these infants as a comparison group due to the degree of variability among sleeping positions.

One may wonder whether gains in development associated with sleep position persist beyond the first six months life. In contrast to the two previously noted studies in which researchers followed infants until only 6 months of age, Dewey et al. (1998) followed infants until 18 months of age. Specifically, the researchers studied the sleeping position and motor milestone attainment of over 10,000 infants in the United Kingdom and asked parents to complete a questionnaire when the infant was 4 weeks, 6 months, and 18-months old that included questions about the position the caregiver places the infant when he/she goes down for the night and when he/she wakes up. When the infants were 6 months and 18 months of age, the researchers also asked parents to complete a questionnaire with questions derived from the Denver Developmental Screening Test-Revised. Unlike other studies previously described, the researchers also examined attainment of the fine motor, communication, and social skills, in addition to gross motor milestones on the Denver Developmental Screening Test-Revised. Dewey and colleagues

found that infants whose caregivers put in them in prone to sleep were significantly more likely than supine sleepers to have a higher gross motor and total score at 6 months of age. However, by 18 months of age, there were no statistically significant differences between infants placed in prone for sleep and those placed in other positions, which suggests that the possible benefit of prone positioning may have been transient. Appendix C provides a summary of the aforementioned studies on the effects of sleep positioning and later development.

Infant development associated with tummy time. Compared to the aforementioned studies that focused on the relationship between *sleep* position and motor development, Salls and colleagues also examined how positioning while *awake* (or "tummy time") is associated with normative gross-motor development. Specifically, the study by Salls and colleagues was one of the first to identify a relationship between the amount of time spent in prone while awake and normative gross-motor development. After researchers began to investigate the effects of sleeping position on development, researchers began to do the same with respect to tummy time. For instance, Salls and colleagues (2002) examined motor milestone acquisition of 66 infants using seven milestones from the Gross Motor Sector of the Denver Developmental Screening Test-Revised at the 2-, 4-, and 6-month well-child visits. The researchers also asked caregivers to identify their infant's primary sleeping position as well as the amount of time that the infant spent in the prone position while awake each day. As too few infants were placed in the prone position for sleep, the researchers compared the motor milestone attainment of infants who slept in the supine and side-lying position. There were no significant differences in milestone attainment between the infants who slept supine and those who

slept side-lying. However, at 2 months of age, infants who spent 15 min or less *awake* time in prone were significantly less likely than the normative population[6] to pass the following milestones: head up 45°, head up 90°, and sit with head steady. Those infants who spent greater than 15 min of wake time in prone were not statistically different from the normative group's pass-fail distributions on those three milestones. That is, 15 min or more of tummy time each day was associated with passing the milestones of head up 45°, head up 90°, and sitting with head steady at 2 months of age. However, there were no significant differences for motor milestone attainment at 4 months and 6 months of age associated with time spent awake in prone.

Whereas Salls and colleagues (2002) examined only gross motor milestones, Majnemer and Barr (2005) examined gross and *fine-motor* development in a sample of 71 4-month old infants and 50 6-month old infants using the Alberta Infant Motor Scale (AIMS; Piper & Darrah, 1994) to assess gross motor skills and the Peabody Developmental Motor Scale (PDMS; Folio & Fewell, 1983) to assess gross- and fine-motor skills. The researchers also asked parents to complete a behavioral diary, in which parents recorded the position of the infant (prone, supine/side-lying, or upright postures) and the behavioral state (asleep, awake and alert, feeding, fussing, or crying) over the course of three days. As the researchers wanted to specifically focus on the motor milestone attainment of supine sleepers, they excluded infants who slept in prone or side-

[6] Salls and colleagues note that researchers developed the norms for the Denver Developmental Screening Test- Revised before the Back to Sleep campaign. As such, they assumed that the normative sample included primarily infants who slept in the prone position for sleep.

lying positions. Compared to the normative sample[7], infants in the 4-month old group were significantly less likely to attain skills that involved antigravity extension of the trunk and neck (i.e., extended arm support in prone, hands to feet in supine, sitting with arm support). Compared to the normative sample, infants in the 6-month old group were significantly less likely to sit without arm support. Further analysis of the behavioral diaries showed that 32.7% of infants in the 4-month old group were never placed in prone position for tummy time, and 75% had less than 20 min of tummy time each day. In the 6-month old group, 27.8% were never placed in prone for tummy time, and half had less than 20 min of tummy time each day. These findings are concerning given the AAP recommendation for infants to have tummy time 2 to 3 times each day for 3 to 5 min. With respect to the amount of tummy time and motor-milestone attainment, the amount of tummy time was positively correlated with the AIMS percentile rank in both the 4- and 6-month old groups. The amount of tummy time was also positively correlated with the fine and gross motor quotients on the PDMS.

Similar to the aforementioned study by Majnemer and Barr (2005), Dudek-Shriber and Zelazny (2007) examined the potential relationship between time spent in certain positions during the day and gross-motor development. Specifically, Dudek-Shriber and Zelanzy assessed 100 4-month-old Australian infants using the AIMS and asked parents to complete a questionnaire in which they noted how much time their infants typically spent in the prone, supine, side, and sitting position while awake and

[7] As with the Denver Developmental Screening Test- Revised, researchers developed the norms for both the AIMS and the PDMS before the Back to Sleep Campaign. As such, one may assume that the normative sample consisted of many infants who slept in the prone position.

asleep, as well as in a walker or stander. Dudek-Shriber and Zelazny found that 60 of the 100 infants typically spent 30 min or less in prone while awake, and that time spent awake in the prone position significantly predicted gross-motor achievement on seven of the 21 prone milestones, three of the nine supine milestones, and three of the 12 sitting milestones. Specifically, significant differences in milestone attainment were associated with prone positioning for 1 hour and 21 min or greater each day (which is substantially more than the AAP recommendation[8]), and those infants who spent more time in the prone position attained many milestones *above* the 4-month old level. In other words, the researchers suggested that infants placed in prone for tummy time may reach gross motor milestones *earlier* than the normative ages for these milestones. For those parents who reported less than 30 min per day of time spent awake in prone, most of these parents reported that the infants did not tolerate the position, which resulted in them terminating tummy time if the baby "became upset." From the perspective of operant theory, infant vocalizations may be negatively reinforced when a parent repositions the infant, and repositioning the infant may be negatively reinforced by the cessation of the infant's negative vocalizations.

Additionally, none of the demographic variables (e.g., birth weight, race, gender, weeks of pregnancy, general infant health) predicted milestone attainment on the AIMS. Interestingly, time spent in prone while awake was associated with some *supine* skills

[8] The AAP (2016) noted, "there are no data to make specific recommendations as to how often and how long it should be undertaken" (p. 7). Although this study offers some preliminary data on the amount of tummy time that may be necessary to foster gross-motor development, additional research is needed so that professionals can offer caregivers evidenced-based recommendations as to how much *daily* tummy time to offer infants.

(i.e., hands to knees, active extension, and rolling supine to prone without rotation) and *sitting* skills (i.e., sitting with propped arms, unsustained sitting, and sitting with arm support; skills that require upper extremity weight bearing or trunk extension). Also notable is that 37 of the 100 parents reported that their infant typically spent greater than 1 hour in the prone position for *sleep*, with some parents reporting up to 16 hours of prone sleep each day. Thus, in addition to pointing to the association between gross motor control and tummy time while awake, the study also points to continued positioning of infants in prone for sleep, despite current safe-sleep recommendations. Appendix D provides a summary of the aforementioned studies on the associations between tummy time positioning and later development. All three of the studies noted above also examined the associations between sleep position and development.

Tummy time and prevention of head deformities.

Plagiocephaly and brachycephaly. In addition to greater delays to reach milestones following the supine sleeping recommendations, there was also rise in the number of infants with cranial deformities following the supine-sleeping recommendations. Graham, Kreutzman, et al. (2005) note that in 1974, the prevalence of plagiocephaly was 1 in 300 births among infants who slept in prone (Dunn, 1974), but in 1996 (after the Back to Sleep Campaign began), the prevalence of plagiocephaly was 1 in 60 births. Specifically, researchers have noted an increase in the incidence of nonsynostotic plagiocephaly (Hutchinson et al., 2003). Nonsynostotic plagiocephaly (also known as deformational plagiocephaly or positional plagiocephaly) is a head deformation in which the back of the head is flattened, and is not caused by craniosynostosis (i.e., premature closure of bones in the skull). Nonsynostotic plagiocephaly is typically caused by external molding forces, such as excessive time spent in the supine position in a crib.

Torticollis (also known as "wryneck") may also develop, due to hemorrhage or scarring within the muscle or muscle shortening (Persing et al., 2003). Torticollis is associated with unidirectional position of the head and can prevent neck motion. Graham, Gomez, and colleagues (2005) reported that all 298 infants they enrolled for the treatment of plagiocephaly had some associated torticollis that required treatment with physical therapy.

Flattening of the head can also lead to brachycephaly, or the shortening anteroposterior dimension (the front to the back of the head) and widening between the biparietal area (the area between the two parietal bones in the back of the skull; Graham, 2006). As the infant brain grows, excessive supine positioning can lead to progressive widening of the head and flattening of the occiput (Graham, 2006). As with plagiocephaly, the primary cause of brachycephaly is constant positioning in supine during infancy and positioning in prone has a protective effect against brachycephaly (Graham, Kreutzman, et al., 2005). Graham and colleagues note that infants' head shapes have become more brachycephalic[9], and brachycephaly is more common in cultures that promote supine sleeping. For instance, Graham, Kreutzman, and colleagues note that, "in Asia, where infants have traditionally been positioned for sleep on their backs, brachycephaly is a normal head shape" (p. 253). Specifically, researchers have found that the mean cranial index among cultures with supine sleeping practices was significantly higher than the mean cranial index in cultures with prone sleeping practices (Graham, Kreutzman, et al., 2005). The mean cranial index in supine-sleeping cultures was also

[9] A cranial index (which is width divided by length multiplied by 100%) greater than 81% is indicative of brachycephaly (Hall, Froster-Iskenius, & Allanson, 1989).

significantly higher than the neonatal cranial index of 80% (which is normocephalic), and the mean cranial index among cultures with prone sleeping practices was not statistically different than the neonatal cranial index. For example, as reported by Graham, Kreutzman, and colleagues, school-aged children in Japan and Korea (which promote supine sleeping) have a mean cranial index that is brachycephalic (i.e., cranial indexes of 85% to 91%).

Brachycephaly and plagiocephaly are preventable by implementing tummy time (Graham, 2006; Persing et al., 2003). Graham (2006) describes how important tummy time is for preventing plagiocephaly and brachycephaly and comments that, "the development of positional brachycephaly, with or without plagiocephaly, is an indication that parents may not be providing their infants with adequate tummy time" (p. 120). Persing and colleagues (2003) note that pediatricians and other clinicians should educate parents on tummy time and other methods that can prevent plagiocephaly (e.g., alternating the position of the infant's head for sleep). If caregivers do not use such preventative methods, infants may need a skull-molding helmet to correct the head deformity, and some infants may require surgery (Graham, Gomez, et al., 2005; Persing et al., 2003).

Parent concerns about head shape. Perhaps due to concerns over plagiocephaly or brachycephaly, many parents are hesitant to place their infants to sleep on their backs. Researchers have found that parent concerns about head shape are associated with the position in which they choose to place their infants (e.g., Hutchinson, Stewart, & Mitchell, 2007). For instance, Hutchinson and colleagues examined infant sleep position and mothers' reported reasoning for the chosen sleep position. The researchers enrolled

278 mothers of 6- to 8-week-old infants and 3- to 4-month infants in New Zealand, and found that 31% of the mothers reported that they were aware of the supine sleeping recommendations but placed their infants in other positions. Of the mothers who usually placed their infants in non-supine positions, 69% reported that they did not place their infant in supine because they were concerned about their infant's head shape. This finding is not surprising, given the relationship between excessive supine positioning and head flattening. Eighty-one percent of all of the mothers reported that they used certain practices to help prevent head deformities. Such strategies included: changing the head position (42% of mothers), changing the infant's sleep position (30% of mothers), placing the infant in prone for tummy time (11% of mothers), using positioning toys[10] (7% of mothers), and using positioning devices for sleep (e.g., foam wedges, rolled up blankets or towels; 6% of mothers). This study points to the prevalence of parent concerns regarding head deformities, and raises additional concerns for infant safe sleep. That is, it is concerning that mothers reported using other sleep positions (e.g., side, prone, or combination) because of worry of head deformities, even when they were aware that the supine sleep position is recommended for safety. Additionally, positional devices like foam wedges and other items in the crib go against AAP recommendations for safe sleep because they can serve as suffocation hazards. As noted by Hutchinson and colleagues, "mothers may be trading SIDS safety issues for fears about head deformation" (p. 246).

Also concerning is that only 11% of mothers who were concerned head shape reported using tummy time to help the infants' head shape. In contrast, 42% of mothers

[10] The authors did not describe what "positioning toys" were, but one may speculate that toys marketed for tummy time (e.g., "tummy-time mats") may have counted as "positioning toys."

varied the infants' head position, and 30% changed the infants' sleep position. One cannot draw any inferences about why the percentage of mothers reporting use of tummy time to help prevent head deformities was comparably low, but it is possible that many parents are not aware that tummy time can help prevent such deformities. As reported by other researchers (e.g., Dudek-Shriber & Zelazny, 2007; Koren et al., 2010; Zachry & Kitzmann, 2011), it is also possible that parents may avoid using tummy time because the infant has difficulty tolerating the position (e.g., infant cries when in the position). Graham (2006) noted that infants who do not consistently experience tummy time consistently become distressed when placed in prone and parents often report that the infant has never tolerated being in this position. Thus, to prevent head deformities, parents may elect to use other strategies that have a lower likelihood of resulting in infant negative vocalizations—such as placement in side-lying or prone for sleep—and which may be lower effort practices for both parent and infant. As previously noted, infant negative vocalizations may be negatively reinforced (e.g., vocalizations stop or are attenuated) when the caregiver repositions infant. It is clear that more research is warranted to examine parents' concerns about head deformities, their reasons for placing infant for sleep and play in various positions, and their knowledge about the protective effects of tummy time to prevent head deformities.

Factors that Affect Positioning

Positioning for sleep. Following the Back to Sleep campaign, researchers studied caregivers' implementation of the safe-sleep recommendations (i.e., their position of choice) and the barriers to implementing the safe-sleep recommendations (e.g., rationale for choosing a certain position). This research has identified racial and socioeconomic

disparities associated with following the recommendations, as well as barriers that include: (a) lack of knowledge, (b) greater trust in family advice than that of medical professionals, (c) perceived infant comfort and sleep quality, as well as (d) perceived safety of the prone position (and lack of safety associated with the supine position).

Racial and socioeconomic disparities.[11] Although the AAP's safe-sleep recommendations have been associated with a substantial decrease in the number of deaths due to SUID, there are racial disparities in these deaths. In 2015, the Centers for Disease Control and Prevention (CDC) identified that SUID deaths among American-Indian/Alaska-Native infants and African-American infants were more than twice that of non-Hispanic White infants. Specifically, per 1,000,000 live births, the SUID rates were 194.1 for American-Indian/Alaska-Native infants and 170.2 for African-American infants, which is more than twice that of non-Hispanic White infants (83.8). In another study, Pollack and Frohna (2001) found that African-American infants are twice as likely to die from SIDS, as compared to Caucasian and Latino infants. Researchers have suggested that caregivers from minority backgrounds may be more likely to place infants in prone for sleep, which explains the disparities in rates of SIDS (e.g., Brenner et al., 1998). For instance, in a sample of African-American infants who died from SIDS, the prone-sleeping position was associated with greater than one-third of those deaths (Hauck et al., 2002). Socioeconomic level is also associated with caregivers placing infants in prone for sleep. Specifically, researchers have found that low-income, minority, and low-educated caregivers are more likely to place infants in prone for sleep (e.g., Brenner et

[11] When discussing the literature, I described participants' races (e.g., "Black" vs. "African-American" using the labels applied by the authors in each study.

al., 1998; Smylie et al., 2014; Willinger et al., 1998; Willinger, Ko, Hoffman, Kessler, & Corwin, 2000). In a recent study conducted by Smylie and colleagues (2014), maternal education was significantly related to mothers placing of their infants in a non-supine position for sleep during the first 4 months of life. Specifically, 34.1% of mothers who did not complete high school placed their infants in prone for sleep compared to 27.7% who had completed high school, and 19.9% who had completed postsecondary education.

In a study of nearly 10,000 mother-infant pairs, Smith, Liu, Helms, and Wilkerson (2012) examined trends in infant sleep positioning from 1996 to 2007. Smith and colleagues found that while there was a significant decreasing trend over time for prone positioning among White infants, there was almost no net change in the prone positioning of Black infants for sleep (i.e., 32.3% placed in prone in 1996 and 32.9% placed in prone in 2007). However, there was an increase in supine positioning and a decrease in lateral positioning for sleep for Black infants (22.6% placed in supine in 1996 and 47.1% placed in supine in 2007; 50.5% placed lateral in 1996 and 20% placed lateral in 2007). In other words, in 1996, the dominant position mothers reported for sleep was the lateral position, whereas in 2007, the dominant position was supine. Despite the decrease in lateral positioning and the increase in supine positioning for sleep, the lack of change in prone positioning observed for Black infants is concerning.

To help explain the racial and socioeconomic disparities in SIDS deaths, researchers have attempted to identify barriers to implementing safe-sleep recommendations. In a qualitative study, Colson et al. (2005) conducted focus groups with 49 New-England area inner-city caregivers to identify potential barriers to implementing safe-sleep recommendations. Eighty-six percent of the caregivers who

participated identified themselves as Black, and 92% were female. In their qualitative analysis of the data, Colson and colleagues identified four core themes that influenced the caregivers' placement of their infants: lack of knowledge about safe-sleep recommendations, advice from other family members, perceived comfort of the prone position, and perceived safety of the prone position. These themes appear throughout the extant literature on barriers to implementing safe sleep practices, and are highlighted below.

Knowledge of safe-sleep recommendations. In one of the initial studies on the implementation of safe sleep following the AAP recommendations, Colson, Stille, Payton, Bernstein, and Dworkin (2000) studied sleeping position and parent concerns about positioning in two inner-city clinics. The researchers found that 31% of parents of infants 30 days old and younger reported that they sometimes placed their infant to sleep in prone. Of these caregivers, 69% reported that the doctor or nurse recommended side-lying[12] and 24% reported that the doctor or nurse recommended supine. Ethnicity, age of parent, language preference, and education were not related to prone positioning. Qualitative data reported by Colson and colleagues (2005) also showed that many parents believe that SIDS could only happen in a crib (possibly because it has been referred to as "crib death"); as such, these caregivers did not put infants to sleep in a crib (Colson et al.,

[12] At the time of the publication of the Colson et al. (2000) article, the AAP recommended non-prone positioning, but noted that, "supine (wholly on the back) confers the lowest risk and is preferred. However, though side sleeping is not as safe as supine, it also has a significantly lower risk than prone. If the side position is used, caretakers should be advised to bring the dependent arm forward to lessen the likelihood of the infant rolling to the prone position" (AAP, 2000, p. 653). The AAP later amended their position on side sleeping and recommended only supine sleeping in their 2005 policy statement.

2005). Colson and colleagues also found that many parents doubted that SIDS existed, and one representative caregiver comment was that, "I know enough to know it doesn't exist. I think that babies just die. I mean, they give it a name. But I don't believe it comes from a certain position that the baby is put in" (p. 352). Other caregivers in Colson and colleagues' study reported that SIDS cannot be prevented and referred to religious and spiritual beliefs as the cause.

Greater trust in family advice compared to medical professionals. Colson and colleagues' (2005) focus groups of inner-city caregivers also identified advice from others—particularly older, female family members with previous child-rearing experience (e.g., the infant's grandmother)—as a contributing factor in how they positioned their infants for sleep. Other research has found that the presence of the infant's grandmother in the home independently predicted the caregiver placing the infant to sleep in prone (Brenner et al., 1998). Herman, Adkins, and Moon (2015) also identified that American-Indian and African-American caregivers' decisions about how and where the infant would sleep were influenced by family and friends with experience raising infants.

Parents may also report greater *trust* in family than health care providers. For instance, Colson and colleagues also found that caregivers often reported foregoing the advice of pediatricians due to lack of trust. One representative comment made by a caregiver in their study was that:

> I listen to the professional. But they're not always right. And I would say that, maybe, we, as black people, we tend to have our own view. But as far as my experience and what I've seen with other families of the same cultural

> background, we tend to be more… well, we'll go to the family first, then a doctor. (p. 352)

Other research has suggested that African-American parents have significantly greater distrust than White parents in medical care and medical research (e.g., Boulware, Cooper, Ratner, LaVeist, & Powe, 2003; Corbie-Smith, Thomas, & St. George, 2002; Rajakumar, Thomas, Musa, Almario, & Garza, 2009). Trust in family instead of health care providers has become such a concern with respect to safe-sleep practices that the NICHD sponsored grass-roots initiatives to educate critical community organizations and community leaders (Colson et al., 2005). Colson and colleagues noted that to promote change in sleep practices, interventions should also include important family members and friends in the discussion of safe sleep and SIDS.

In the aforementioned research reported by Colson and colleagues (2000), caregivers reported distrust of health care providers and noted that they were "constantly changing their minds about the recommended sleeping position for infants" and that they were "worried that health care providers did not really know what SIDS was or what caused it and were therefore just guessing at which position was better" (p. 352). Herman and colleagues (2015) found that American-Indian and African-American caregivers also reported confusion about the recommendations because they have been changed over the past 30 years.

Perceived infant comfort and sleep quality. In the aforementioned study by Colson et al. (2000), there was a significant relationship between parents who had older children or who had someone at home who slept in prone, and the likelihood of placing the infant in prone for sleep. As noted by Colson and colleagues, parents with older

children may be more likely to place their infants in prone if they thought that the older children slept longer or were more comfortable in prone.

Other research has noted that parents choose the prone sleeping position because of perceived infant comfort or better infant sleep in the position. For instance, in the National Infant Sleep Position Study, 82% of caregivers who placed infants in prone to sleep reported doing so because "the baby likes it better and/or sleeps better than way" (Willinger, Ko, Hoffman, Kessler, & Corwin, 2000). Similarly, in the previously described study by Hutchinson and colleagues (2007), 40% of mothers who placed their infants in non-supine positions for sleep reported doing so because the "infant sleeps better." In a separate study of nearly 400 mothers, 36% of mothers placed their 3- to 7-month old infants to sleep in prone. Of those mothers, 58% reported doing so because the infant was more comfortable in that position (Brenner et al., 1998). These data are also supported by qualitative data reported Colson and colleagues (2005) from their focus groups of inner-city caregivers. For instance, one caregiver commented that she places her infant "…on his stomach. And I know that that's against current pediatric guidelines but that's the way he's most comfortable and that's the position that he sleeps the longest in" (p. 351).

Perceived safety of the supine and prone positions. A number of studies have shown that parents are concerned about the safety of the *supine* sleeping position. For instance, in the study by Colson and colleagues (2000), 56% of parents in the study reported that they were concerned about having their infant sleep in supine. Ninety-five percent of these parents were concerned that the infant might choke in the supine position. Conversely, 66% of parents were concerned about the *prone* sleeping position.

Of these parents, 62% were worried that the infant might suffocate in the position. Thus, parents were almost equally as likely to report concerns about the prone position compared to the supine position. In the aforementioned study by Brenner and colleagues (1998), of the mothers who reported placing the infant in prone for sleep, 27% reported doing so to prevent the infant from choking. These concerns are also supported by qualitative data reported by Colson and colleagues (2005), who found that caregivers in each of their focus groups expressed concerns about their infants' safety while sleeping. Specifically, the caregivers reported that they did not think it was safe to place infants in the supine position because they would choke, providing comments such as, "it just seems obvious that they can choke like that… at that young age, they can't turn themselves over. They can't do anything. They're just laying there" (p. 351). Caregivers reported that the prone position was safer; for instance, one caregiver noted that:

> If they're on their stomach, it will come out easier…sometimes it's hard to hear your baby when they're gagging, if that was the case. So I preferred the stomach for both of my daughters. And I'm going to do it with him, too. (p. 351)

Other caregivers provided similar rationale and some caregivers described being so concerned about the infant at night that they brought their infants into their beds to be able to better observe them.

Similarly, the National Infant Sleep Position Study found that parents choose the side-lying position because of fears of the infant vomiting, choking, and spitting up in the other positions (Willinger et al., 2000). Willinger and colleagues comment that concerns of vomiting or choking appear to be unwarranted, as researchers have observed no increased risk of choking among supine-placed infants 4 to 6 weeks of age and those 6 to

8 months of age (e.g., Hunt, Fleming, Golding, and the ALSAP Study Team, 1997). These data are supported by other research that has found no adverse health outcomes (e.g., breathing problems) among 1-month old infants who slept supine (Ponsonby, Dwyer, & Couper, 1997). These data point to a need for caregiver education to communicate the safety of the supine sleeping position.

Positioning for play.

General awareness of tummy-time recommendations. More recently, researchers have also examined caregivers' knowledge of the AAP's *tummy-time recommendations* and barriers to implementing those recommendations. However, there is limited research on caregiver's knowledge of tummy-time recommendations. Koren, Reece, Kahn-D'Angelo, and Medeiros (2010) conducted one of the only studies on caregivers' awareness of tummy-time recommendations and the sources of those recommendations. Koren and colleagues administered the Infant Positioning Survey (IPS; developed for their study) to 119 mothers[13] of healthy newborns in an urban hospital in northeastern Massachusetts. Sample questions included: "Have you ever received any information about how to put your baby down when he/she is awake?" "Have you received any information about how to put your baby down when he/she is asleep?" Researchers also asked mothers what position was recommended for sleep and play and for the source of those recommendations. When the infants were 2-months old, the researchers interviewed

[13] Although Koren and colleagues did not report whether mothers' knowledge was related to any demographic characteristics, a majority of the mothers were white, nearly half had a college degree or additional college, 42% were eligible for Women, Infants, and Children (WIC), average maternal age was about 29 years, and 36.9% were first-time parents.

88 of the initial 119 mothers and asked them to report the position of the infant "most of the time."

Approximately 10% of mothers reported that they received no information about how to position for sleep, whereas 44.54% reported that they received no information about how to position when awake. Approximately 80% reported that they were told to position the infant on their back for sleep, and 17.65% reported that they were told to position the infant on their back when awake. About 15% reported being told to place the infant on their tummy when awake. A smaller percentage of mothers (11.76%) reported that they were told to rotate between the tummy and back when awake. Sources of the recommendations were: nurses on the parent-infant floor (38.6%), physician in hospital (3.3%), pediatrician (14.28%), relative or friend (12.6%), media magazines/newspapers (8.4%), and previous experience (12.6%).

When the infants were 2-months old, interviews with the mothers indicated that infants were placed on their back "most of the time" for both sleep and play (i.e., 79.31% when asleep, 70.11% when awake). In contrast, 8% of mothers reported placing the infant in prone while awake "most of the time." Although most mothers reported that they place their infants on their backs most of the time while they are awake, all but one mother reported positioning their infants in prone for tummy time, at least one time each day. The amount of tummy time arranged by mothers, "per episode" varied between 0-2 min and greater than 10 min. In light of the AAP's recommendation to conduct tummy time 2 to 3 times per day for 3 to 5 min, the mothers' provision of tummy time with their infants is fairly consistent with the AAP recommendation. However, as the aforementioned research by Dudek-Shriber and Zelanzy (2007) found that gross-motor

milestone attainment on the AIMS was associated with prone positioning for *greater than 1 hour and 21 min a day*, the amount of tummy time the mothers reported in Koren and colleagues' study may have been insufficient to produce any developmental gains. Additionally, most mothers reported receiving no information about tummy time (44.54% of mothers) or receiving information that is inconsistent with the AAP recommendations (e.g., to position only on back while awake, 17.65% of mothers).

In one of the only other studies on caregiver awareness of tummy-time recommendations, Zachry and Kitzmann (2011) administered questionnaires about tummy time knowledge and practices to caregivers[14] of healthy infants birth to 24 months of age residing in Tennessee. Similar to Koren and colleagues' (2010) study, Zachry and Kitzmann asked the caregivers about their awareness of the AAP tummy-time recommendations and the sources of those recommendations. Additionally, Zachry and Kitzmann asked participants about their awareness of complications that could arise if tummy time is not provided, the amount of tummy time the caregiver provided and how well the infant tolerated tummy time, and the rationale for not providing tummy time if the caregivers were aware of the recommendation.

Of their 205 participants, 75% of caregivers who were aware of the safe-sleep recommendations were aware of the tummy-time recommendations. Of these caregivers,

[14] Similar to Koren and colleagues' (2010) study, Zachry and Kitzmann (2011) provided participants' demographic information but did not include an analysis of how demographic data may have been related to caregiver knowledge and implementation of tummy time. Of the questionnaires they received, 90% were completed by mothers, mean age of caregivers was approximately 29 years, half had a completed college or had a graduate degree, and approximately 25% reported a household income ≤ $20,000. Zachry and Kitzmann provided infant (not caregiver ethnicity); 57% were European American, 33% were African American, 3% were Asian, and 6% were other or "mixed."

another 75% were aware of complications that may arise as a result of limited tummy time. Most parents reported receiving information about tummy time from printed materials (19.5%), followed by pediatricians (15.1%), friends/family (10.2%), hospital staff (8.8%), media (4.9%), nurses (3.9%), and other sources (3.4%). Similar to the study by Koren and colleagues' (2010), only a comparatively small percentage of caregivers reported that their pediatrician provided information about tummy time.

Research by Koren and colleagues (2010) and Zachry and Kitzmann (2011) comprise the only two studies to explicitly study caregiver awareness of the AAP tummy-time recommendations, and both studies identified that most participants were aware of how to position their infants for sleep, but not for play. It is important to also understand why caregivers do not conduct tummy time, when they are aware of the AAP recommendations. In the extant literature, three major reasons for parents' resistance to conduct tummy time appear: (a) fear that tummy time places infant at an increased risk for SIDS (Davis et al., 1998), (b) confusion regarding the recommendations (Jennings, Sarbaugh, & Payne, 2005; Koren et al., 2010), and (c) infant intolerance of the position (e.g., crying, fussing; my. Dudek-Shriber & Zelazny, 2007; Jennings et al., 2005; Koren et al., 2010; Zachry & Kitzmann, 2011).

Fear that tummy time places infant at risk for SIDS. As previously noted, parents have reported concerns about the safety of the supine sleeping position for *sleep*. Likewise, research has also shown that parents have concerns about prone positioning for *play*. Davis et al. (1998) studied the relationship between sleep position and infant motor development (study previously described). In their survey, the researchers found that

parents avoided placing their infant in prone while awake because they were worried that the position may cause SIDS.

Lack of clear recommendations. As reported in the literature on caregiver knowledge of safe sleep, caregivers also report confusion regarding tummy-time recommendations. The current literature points to confusion from: (a) the original AAP tummy-time recommendations, (b) tummy-time recommendations provided by health care providers, and (c) tummy-time recommendations provided on the Internet.

AAP recommendations. With respect to the AAP recommendations regarding tummy time, the AAP Task Force initially noted in their 1996 report that, "A certain amount of 'tummy time,' while the infant is awake and observed, is recommended for developmental reasons and to help prevent flat spots on the occiput" (AAP, 1996, 2000). As previously noted, it was not until 2008 that the AAP published any specific recommendations regarding tummy time. In 2008, in collaboration with Healthy Child Care America, the AAP published their "Back to Sleep, Tummy to Play" pamphlet for caregivers. In the pamphlet, the AAP recommended that from the first day home from the hospital, the caregiver can "play and interact with the baby while he is awake and on the tummy 2 to 3 times each day for a short period of time (3-5 minutes), increasing the amount of time as the baby shows that he enjoys the activity." However, it seems that these more specific recommendations to conduct tummy time--*16 years* after the original 1992 AAP recommendation to place infants in supine for sleep—came a bit too late. As noted by Koren and colleagues (2010), the *tummy-time recommendations* in the AAP's pamphlet also lack the specificity they provided for *safe-sleep recommendations*.

Health care providers' recommendations. Health-care providers also report confusion regarding the AAP's recommendations. Research by Jennings and colleagues (2005) found that physicians' recommendations about the amount of time to implement tummy time varied greatly, with some physicians recommending 15 min of tummy time a day, and others recommending 45 min a day. As a part of their larger study on parent and provider understanding of tummy-time recommendations, Koren and colleagues (2010) conducted focus groups with nine pediatric providers (e.g., pediatricians, nurses). Sample questions that the researchers asked included: "What is your interpretation of the recommendation for time spent on the tummy per day in young infants?" "What do you recommended to parents?" and "How do parents interpret your recommendations about tummy time?" Koren and colleagues found that although the providers discussed SIDS prevention at each well-child visit, they provided informal, "random" counseling about tummy time beginning when the child was 2 to 3 months of age. As tummy time should be conducted the first day the infant is home from the hospital, Koren and colleagues' research suggests that providers' counseling about tummy time to parents may be conducted too late.

Koren and colleagues also found that providers overwhelmingly noted that: (a) they often did not have time to discuss tummy time, (b) were confused themselves about the tummy time guidelines, and (c) feared legal implications. The providers commented that discussion of SIDS was a priority over tummy time because SIDS is a *safety concern*, and described perceived parent barriers to implementing tummy time, which included: (a) parents' fear, (b) the infant's frustration during tummy time (noted previously), and (c) the parents' cultural practices.

Recommendations on the Internet. Top parenting websites also provide wide variability of information on tummy time in terms of age to begin tummy time and the frequency and duration of tummy time (Koren et al., 2010). As a part of Koren and colleagues' larger study on parent and provider awareness of tummy-time recommendations, they conducted an Internet search of tummy-time recommendations on parenting websites that appeared following a Google search of "parenting." Koren and colleagues found that of those websites that provided information on tummy time, recommendations of *when to begin* varied; some recommended beginning at birth whereas others recommended beginning between 3 to 6 months of age. Tummy time *duration* on the parenting websites also varied; between websites, tummy-time recommendations ranged from as little as 10 s to as much as 30 min to an hour each day. Websites also varied in their recommendations on *how* to conduct tummy time (e.g., on lap, on rolled up blanket, with toys). Such variety of parenting information provided on the Internet is not limited to tummy-time recommendations. Given that parents often use the Internet to seek health-related information regarding their child (e.g., Tuffrey & Finlay, 2002), the variety of tummy-time recommendations provided on top parenting websites may be associated with some of the reported parent confusion about tummy time noted in the literature.

Infant intolerance of tummy time. Research has identified that caregivers report not conducting tummy time because the infant does not tolerate the position, and as such, they do not follow their health care providers tummy-time recommendations (Dudek-Shriber & Zelazny, 2010). In a study by Zachry and Kitzmann (2011), of caregivers who reported being aware of tummy-time recommendations, only 47% reported that their

infants tolerated tummy time. Infant intolerance of tummy time was also associated with less daily time; 44.4% of the infants who caregivers reported were intolerant of tummy time had ≤ 15 min of tummy time each day. However, it is not known what percentage of those infants had about 15 min of tummy time (which is in line with the AAP recommendation) vs. those infants who had zero or near zero tummy time each day. Koren and colleagues (2010) found that health care providers recommended between 2 and 15 min of tummy time *as tolerated by the infant*, a few times a day. As reported by one provider in Koren and colleagues' study, "…all of our parents also have three kids at home, so if there is one frustrated on the floor, she is not going to let him stay on the floor" (p. 228). Additionally, in the aforementioned "Back to Sleep, Tummy to Play" pamphlet, the AAP noted that some babies might not like tummy time at first and recommended that caregivers place toys or themselves in front of the child to look at during tummy time. However, with the exception of this dissertation, the individual and combined effectiveness of toys and caregiver interaction has yet to be empirically evaluated.

Recommendations to improve infant intolerance during tummy time. Tummy-time recommendations provided to parents often include suggestions to include toys or interaction (e.g., AAP, 2008). Although Kadey and Roane (2012) did not specifically use a toy (e.g., a rattle), the researchers systematically evaluated the provision of a preferred video on a 7-month-old infant's negative vocalizations (e.g., crying, fussing) during tummy time. During baseline sessions, the participant was placed prone in front of a white backdrop and without access to any tangible or auditory stimuli (i.e., no toys, music, or experimenter attention was delivered). Treatment sessions were identical to

baseline sessions with the exception that the experimenter placed a preferred video slightly above the participant's head. This modification was associated with an increase in mean duration of elevated head from approximately 40% in baseline to approximately 83% in treatment, and a decrease in mean duration of negative vocalizations from approximately 64% of baseline sessions to 0% of treatment sessions (i.e., access to the preferred video was associated with complete elimination of negative vocalizations).

In a similar study, Ortega and Fienup (2015) evaluated the effectiveness of an auditory sensory book with and without maternal attention on a 14-week old infant's negative vocalizations and head elevation. As in the Kadey and Roane (2012) study, in baseline, the infant faced a white backdrop and no attention or other stimulation was provided. During these sessions, the infant engaged in negative vocalizations for 99% of the sessions and elevated his head for 12% of the sessions. Treatment sessions were identical to baseline, except the infant's mother held the auditory book in front of the infant's head and activated it so it made sound throughout the session (preferred-stimulus condition) or activated the book while also providing continuous praise (preferred-stimulus + attention condition). These interventions were very effective at decreasing negative vocalizations; the mean percentage of session with negative vocalizations decreased from 99% of baseline sessions to 29% of the preferred-stimulus condition and 13% of the preferred stimulus + attention condition. Additionally, these interventions were also associated with an increase in mean percentage of session with elevated head from 12% in baseline to 68% in the preferred-stimulus condition and 87% in the preferred stimulus + attention condition.

To date, Kadey and Roane (2012) and Ortega and Fienup (2015) are the only studies reported in the literature that systematically evaluated interventions for tummy-time intolerance. Although the results of these studies are promising, the results are limited in generality as each study only included one participant. Additionally, neither study examined the effectiveness of toys and interaction in isolation and in combination. With respect to intervention in Kadey and Roane (2012), the AAP (2016, October) released new recommendations about young children's media use, and recommended that children under 18 months of age avoid the use of screen time. As such, it may be important to identify toys (e.g., play mats, mirrors, rattles), which are effective in reducing infants' negative vocalizations and increasing head elevation. Additionally, in Ortega and Fienup's preferred-stimulus only condition, the mother was in front of the infant to activate the book (but not delivering attention). Thus, although she was not interacting with the infant, the presence of the mother alone could have affected the results. To enhance tummy-time recommendations, it may be important to isolate the individual and combined effects of toys and interaction on infant behavior during tummy time.

It is also important to identify the effectiveness of such stimuli in reducing infant negative vocalizations, as infants' cries can be extremely aversive to caregivers and place infants at-risk for child abuse (Frodi & Lamb, 1980; Reijneveld, van der Wal, Brugman, Sing, & Verloove-Vanhorick, 2004). Infant crying is also associated with poor caregiver mental health, such as maternal depressive symptomology (e.g., Radesky et al., 2013). Additionally, as the results in Zachry and Kitzmann (2011) suggest, infant intolerance of tummy time may be associated with caregivers providing less tummy time, which can

impact development. The AAP (2008, 2017a) provides recommendations for tummy time, such as providing toys, interacting with the infant on the floor, or interacting with the infant chest to chest. However, the effects of these activities on infant behavior during tummy time have not been empirically assessed in a compelling fashion. It follows that, if we are to speak about the importance of tummy time for development and recommend tummy time when it is difficult for infants, we should formally test the recommendations to use toys and adult interaction during tummy time. Additionally, as parents report being confused about positioning recommendations, we should evaluate more efficient and effective ways to inform parents of these recommendations.

Summary

Proper positioning during the day for play and at night for sleep is critical for both the infant safety and motor development and safety. However, the current literature indicates that caregivers experience a number of barriers to implementing the AAP's guidelines for safe sleep and tummy time, including confusion about the recommendations, lack of trust in health care providers' recommendations, concern about the safety of sleep and play positions, previous family and cultural practices, and infant intolerance of the supine position for sleep or the prone position for play. Although there has been limited research conducted on awareness and implementation of the AAP positioning recommendations, the aforementioned research points to racial and socioeconomic disparities in implementation of safe-sleep practices. Additionally, participants in these studies are generally mothers. As other caregivers (e.g., fathers) often share in the responsibilities of caring for an infant, their awareness and implementation of the AAP recommendations should also be evaluated.

Research on demographic variables associated with safe sleep has focused on behavior (i.e., parents' actual practices) and very little research has examined demographic variables that are associated with *knowledge* of safe-sleep practices. Further, no published studies to our knowledge have examined parents' and expectant parents' knowledge about safe sleep and tummy time. As the AAP recommends that tummy time be conducted the day that the infant comes home from the hospital, the optimal timing of tummy time education should be before the baby is even born. Additionally, to more fully understand the knowledge and practices of today's caregivers with respect to positioning of infants, researchers should study knowledge and practices with more diverse groups of participants (i.e., pregnant women, fathers, caregivers from minority and majority races).

Current research suggests that education efforts should be directed at informing parents of both the *safety* and *importance of* providing supervised tummy time. Following the "Back to Sleep, Tummy to Play" pamphlet published in 2008, there have been only two studies reported in the literature on *caregivers' awareness* of tummy-time recommendations (i.e., Koren et al., 2010; Zachry & Kitzmann, 2011). Additionally, to our knowledge, there are no published studies that have evaluated methods to educate parents on the AAP's safe-sleep *and* tummy-time recommendations. Although a number of videos about safe sleep and tummy time exist, discussion of safe sleep and tummy time are treated as separate topics. That is, my own review of current videos available online has found that existing videos generally cover *only* safe sleep or *only* tummy time. As the AAP published their safe-sleep recommendations *with* recommendations about tummy time, it follows that these two topics should be jointly discussed.

Overall, the current research points to a need for better educational tools to teach parents and others about proper infant positioning. That is, given the confusion reported by both caregivers and providers on the AAP recommendations, it seems that these recommendations are not effectively reaching their targeted audiences. It follows that, to increase caregivers' knowledge of how to position infants for sleep and play, researchers must identify more effective educational tools. Research has documented the importance of providing new and experienced parents with anticipatory guidance on positioning recommendations (Colson et al., 2000).

Finally, researchers have identified a common barrier to implementing tummy time-- infant intolerance of the position. For those infants who are intolerant during tummy time (e.g., cry, scream), caregivers' avoidance of tummy time or termination of tummy time when the child cries may negatively reinforce the caregivers' behavior (i.e., they may continue to not conduct tummy time or terminate tummy time early because doing so also terminates infant *crying*). Additionally, the AAP recommends tummy time for "2 to 3 times a day for a short period of time (3-5 min), increasing the amount of time as the baby shows he enjoys the activity;" but what should caregivers do if their infants show that they do not enjoy the activity? Although the AAP recommends that caregivers use toys and interaction during tummy time, the AAP provides limited guidance on how to address such infant intolerance. Given the importance of tummy time for infant development and the frequency with which infant intolerance of tummy time is reported in the literature, research should be conducted on methods to improve tolerance (e.g., decrease negative vocalizations).

Chapter 2: Overview of the Current Study

General Aims

Considering the aforementioned limitations of the current literature, the purpose of the current study was to: (a) evaluate knowledge of the safe sleep and tummy-time recommendations, and barriers to implementing those recommendations, (b) evaluate the effectiveness of a video to improve caregivers' knowledge about positioning recommendations, and (c) evaluate the effectiveness of two commonly recommended interventions (i.e., access to a toy and adult interaction) on negative vocalizations and head elevation during tummy time.

Thus, the current experiment aimed to address the gaps in the existing literature with two experiments. The first experiment aimed to evaluate caregiver knowledge of the AAP positioning recommendations and barriers to implementing those recommendations. Specifically, the experiment examined the knowledge and implementation of tummy time among (a) caregivers with a child 3 years of age and younger and (b) first-time, expectant parents. As tummy time should be conducted the first day the infant comes home from the hospital, it was important to evaluate what expectant parents know about the AAP positioning recommendations. Additionally, to address other aforementioned gaps in the literature, efforts were made to recruit caregivers from diverse racial, ethnic, and socioeconomic backgrounds. Furthermore, in addition to mothers, other caregivers (i.e., legal guardians) were invited to participate. By recruiting a more diverse sample of participants than in previously described studies, one may be able to determine whether relationships exist between positioning knowledge, practices, and demographic characteristics. Such information may have implications for application (e.g.,

interventions should also focus on educating fathers on the importance of safe sleep and tummy time).

A second aim of the first experiment was to evaluate whether an educational video—created specifically for this study—enhanced caregivers' knowledge of the AAP recommendations. As noted in the current literature, pediatricians and other health care professionals report not having time to discuss tummy time with caregivers. As such, if a video is effective at enhancing caregiver knowledge of positioning recommendations, such a video could serve as an important educational tool for caregivers to view during their appointment (e.g., while a pediatrician completes paperwork) or from the comfort of their own homes (e.g., via a smartphone application).

There are a number of implications for studying parent knowledge of infant positioning recommendations in Maryland. Educating parents living in the Baltimore Metro and surrounding areas may be especially important, given the recent estimates of infant mortality in the area. In 2015, the Maryland Vital Statistics Administration reported that infant mortality rates in Maryland in 2015 were slightly higher than the national rates (i.e., 6.7 and 5.9 deaths per 1,000 live births, respectively), and that there was a 36% increase in the number of infants who died from SIDS in Maryland between 2014 and 2015. With respect to Baltimore City, between 2009 and 2015, there were 115 infant deaths during sleep and the infant was sleeping in an unsafe sleep environment in 109 of the 115 deaths. As Dr. Leana Wen, the Baltimore City Health Commissioner, noted in a July 2015 press release:

> Education is the key to changing behavior to prevent these tragic deaths . . . That means everyone needs to know the ABCs of Safe Sleep—that babies should be

> put to sleep Alone, on their Backs, and in Cribs, without exposure to second-hand smoke. No exceptions. This is the best way to ensure babies stay healthy and are ready to thrive…there is still work to do; seven babies have died in their sleep so far this year in Baltimore.[15]

Given these recent estimates of infant deaths in Maryland, providing safe-sleep education to parents—and first-time, expectant parents—is warranted.

Experiment 2 aimed to address the effects of commonly recommended interventions for negative vocalizations during tummy time. Specifically, we evaluated both toys and experimenter interaction in isolation and in combination to determine if these procedures resulted in a reduction of negative vocalizations. We also examined the effectiveness of a parent-led intervention on negative vocalizations, wherein the mother interacted with the infant and showed him/her toy, while he/she laid on her chest. Also, in keeping with Kadey and Roane (2012) and Ortega and Fienup (2015), we recorded the amount of time that the infants lifted their heads throughout the experiment to determine if toys and interaction produced other developmental gains. Additionally, as the experimental conditions may be associated with qualitatively different "levels" of head elevation that vary in the degree of developmental sophistication (e.g., head up only vs. head *and* chest up) we also recorded the infants' specific levels of head elevation.

[15] This press release refers to the number of deaths that occurred in Baltimore between January and July 2015.

Chapter 3: Experiment 1

Experiment 1 Aims and Hypotheses

There is limited research on caregivers' knowledge of positioning recommendations for sleep and play, especially that of first-time, expectant parents. Experiment 1 examined knowledge of the AAP's safe-sleep and tummy-time recommendations among (a) parents of children 3 years of age and under and (b) first-time, expectant parents. We also evaluated the effectiveness of a video created specifically for this study on increasing knowledge of the recommendations, and gathered information on parents' practices and expectant parents' planned practices of positioning their infants for sleep and play. The hypotheses for Experiment 1 were as follows:

Hypothesis 1. Is an experimenter-developed educational video on safe-sleep and tummy-time recommendations associated with gains in caregiver knowledge about these positioning recommendations? *It was expected that the video would be associated with gains in caregiver knowledge about both safe-sleep and tummy-time recommendations for both first-time, expectant parents and current parents.*

Hypothesis 2. Does knowledge of the AAP's *safe-sleep* recommendations differ between parents of children 3 years of age and younger and first-time, expectant parents? *Based on the literature, many parents learn about safe sleep from their pediatrician and hospital staff following the birth of their infant. Therefore, it was expected that parents of children 3 years of age and younger would report greater knowledge than first-time, expectant parents of the safe-sleep recommendations.*

Hypothesis 3. Does knowledge of the AAP's *tummy-time* recommendations differ between parents of children 3 years of age and younger and first-time, expectant parents?

Based on the literature, many parents learn about tummy time from their pediatrician and hospital staff following the birth of their infant. Therefore, it was expected that parents of children 3 years of age and younger would report greater knowledge than first-time, expectant parents of the tummy-time recommendations.

Hypothesis 4. Is knowledge of the AAP's *safe-sleep* recommendations related to specific caregiver demographic characteristics? *Given the current literature, unsafe sleep practices are common among caregivers from low-SES backgrounds and those from minority groups. Therefore, it was expected that caregivers from these groups would report less knowledge of the AAP's safe-sleep recommendations relative to caregivers from high-SES backgrounds and majority races.*

Hypothesis 5. Is knowledge of the AAP's *tummy-time* recommendations related to specific caregiver demographic characteristics? *As with knowledge of safe-sleep recommendations, it was expected that caregivers from these groups would report less knowledge of the AAP's tummy-time recommendations relative to caregivers from high-SES backgrounds and majority races.*

Method

Participants, setting, and materials. Participants were: (a) first-time, expectant parents (Expectant-Parent Group) and (b) parents (i.e., legal guardians) of infants aged birth to 3 years (Parent Group). Estimation of sample size through *a priori* power analysis using GPower (Erdfelder, Faul, & Buchner, 1996) and calculating for a moderate effect size of 0.25[16] indicated that 49 participants would be needed in each of the two

[16] Cohen's f effect size of 0.25 was selected based on Cohen's (1998) definition of a medium effect size.

main groups (Expectant-Parent and Parent Group). We then grouped participants by SES for a total of four groups: the (a) High-SES Expectant Parent Group, (b) Low-SES Expectant Parent Group, (c) High-SES Parent Group, and (d) Low-SES Parent Group. We stratified participants into respective SES groups by their reported insurance type on initial questionnaires. Specifically, we included participants who reported "private insurance" in the High-SES Expectant Parent or Parent Group, and those who reported "medical assistance" or "no insurance" in the Low-SES Expectant Parent or Parent Group. There were 79 parents and 42 expectant parents in the study, for a total of 121 participants. Of the 121 participants, there were 33 high-SES parents, 46 low-SES parents, 24 high-SES expectant parents, and 18 low-SES expectant parents.

We recruited participants via printed and electronic flyers that we distributed to a variety of locations and groups including: obstetric/gynecologic (OB/GYN) clinics and pediatric clinics, family practitioner practices, family support centers, Early Head Start and Head Start Programs, Infants and Toddlers Programs (i.e., early intervention programs), local parenting groups on social media, libraries, infant car seat safety checks, prenatal yoga classes, childbirth classes, children's clothing consignment sales, department stores for baby items, and childcare centers throughout Maryland. The primary experimenter held 10 meetings in various areas of Maryland: three in Baltimore City, two in Baltimore County, one on the Eastern Shore, two in Southern Maryland, and two in Western Maryland. Seven of the 10 meetings were held as a part of focus groups associated with a larger research project conducted by the University of Maryland School of Medicine and funded by the Wright Family Foundation to gather information

regarding parents' perceptions of early childhood care and education[17]. We also invited participants who were not able to attend one of the aforementioned meetings or who preferred to participate one-on-one or in a small group (e.g., with a significant other) to schedule an appointment at their home or in a local community setting (e.g., library).

On the flyer, we informed participants that we would like to (a) determine the potential value of a smartphone application to help parents and professionals enhance the care and development of young children prior to Kindergarten (only for the meetings associated with the larger study previously described) and (b) evaluate whether an educational video can help parents learn more about positioning infants for sleep and play (only the latter of which is relevant to the proposed research). The flyer also noted the (a) day and time of the focus group for each of the four locations, (b) that the focus group would be up to 2 hr[18], and (c) that participants would receive a $10 gift card to a department store for their participation. Materials for the study included a laptop and projector to show the video, as well as questionnaires and gift cards for the participants. For one-on-one or small group participation with the primary experimenter, the participants viewed the video on individual iPads.

Procedures. The University of Maryland, School of Medicine's and the University of Maryland, Baltimore County's Institutional Review Board (IRB) approved

[17] The Aethena Group, LLC was a partner in the aforementioned research project conducted by the University of Maryland School of Medicine. The Aethena Group is a small business in Maryland that has designed a smartphone application, known as "eB2K" (Education from Birth to Kindergarten). Some of the goals of eB2K are to improve parent-provider relationships, help refer children and their families to resources in the community (e.g., early intervention programs), increase parents' knowledge about child development, and ultimately, enhance school readiness.

[18] Although we expected the focus group to be approximately 1 hr, we expected that the surveys and video as a part of the experimenter proper would take an additional hr.

this study. We obtained consent from all participants at the beginning of the study. Then, we informed participants that they would complete a: (a) Demographic and Personal Practices Questionnaire regarding participant demographics as well as past or current positioning practices for sleep and play (Parent Group) or planned positioning practices (Expectant-Parent Group) and (b) Pre-Test Questionnaire knowledge of positioning recommendations. Next, we informed participants that following the questionnaires, they would watch a short video about infant positioning recommendations, and that after the video, they would complete the same pre-test questionnaire, again, to determine if that video improved their knowledge about the positioning recommendations. Participants completed the questionnaires in the paper-and-pencil format.

Demographic and Personal Practices Questionnaire. The Demographic and Personal Practices Questionnaire was adapted from one reported by Zachry and Kitzmann (2011), and gathered information with respect to participants' practices of positioning their infants for both sleep and play. In contrast to the questionnaire reported by Zachry and Kitzmann, the main questions in this questionnaire addressed: (a) how the participants positioned their infants (e.g., back, side, tummy) for both sleep at night as well as for naps (i.e., Zachry & Kitzmann asked about overall positioning for sleep), (b) the rationale for placing infant in position noted for naps *and* sleep at night, (c) where participants placed their infants for both sleep at night and naps (e.g., crib, swing), (d) when participants received information about positioning for sleep, (e) when participants received information about tummy time, and (f) if worried, the rationale for worry about putting baby on tummy while he/she was awake (e.g., fear of baby choking). Similar questions were posed to the Expectant-Parent Group as the Parent Group, but were

phrased as, “How much total time, each day, do you *plan* to place your baby on his/her tummy while awake?” or “What position do you *plan* to place your baby to sleep at night?” We adapted the questionnaire reported in Zachry and Kitzmann as parents may position infants differently and/or in different locations for sleep at night as compared to naps. Additionally, we wanted to gather more information about participants’ *reasons* for their chosen positioning practices for naps vs. sleep at night, to understand more about infants’ behavior when their caregivers placed them on their tummies, and to determine when participants were receiving information about positioning for sleep and play.

As a part of the Demographic and Personal Practices Questionnaire, we asked participants in both groups to answer some demographic questions, including their: (a) age and gender, (b) income, (c) ethnicity, (d) highest level of education, (e) marital status, (f) month and year of birth of all children (relevant to Parent Group only), and (g) gestation (in weeks; relevant to Expectant-Parent Group only). We presented possible answers to each of the questions in a multiple-choice format, with the exception of the question asking for the month and year of birth of children, which we presented in a short-answer format. Appendix E provides the demographic and personal practices questions for the Expectant-Parent Group, and Appendix F provides the demographic and personal practices questions for the Parent Group.

Pre-Test Questionnaire. After completing the Demographic and Personal Practices Questionnaire, participants completed the Pre-Test Questionnaire to evaluate participants’ knowledge of the AAP’s safe-sleep and tummy-time recommendations. Questions in this questionnaire addressed: (a) what items or practices are associated with safe and unsafe sleep, (b) in what position and where *a doctor would say* a baby should

be placed for sleep at naps and at night, (c) what are the "ABCs" of safe sleep, (d) is tummy time important for development, and if so, why, (e) how much tummy time should infants have each day, and (f) what things can caregivers do to help infants enjoy tummy time. The experimenter asked the participants to answer these questions using both multiple-choice and short-answer responses. We presented these questions aimed at identifying participants' knowledge of the AAP recommendations again after viewing the video, and these questions comprised the *Post-Test Questionnaire* (see below). The Pre- and Post-Test Questionnaire is presented as Appendix G. Responses that are bolded indicate the correct responses to those questions.

Video. Following completion of the Demographic and Personal Practices Questionnaire as well as the Pre-Test Questionnaire, participants watched a 9.5-min video about the AAP's safe sleep and tummy-time recommendations. We created the video specifically for this study and derived information in the video from the AAP safe-sleep and tummy-time recommendations. The video provided answers to all questions addressed in the pre-test questionnaire, and included video and images to demonstrate appropriate positioning practices. Prior to showing the video to any participants, we asked a developmental pediatrician, a pediatrician, a developmental specialist, and six caregivers of young children (i.e., four mothers, one father, and one grandmother; five of the six caregivers cared for newborns) to view the video, provide feedback, and vet it. After gathering feedback from these viewers, we made some minor changes to the video to increase the clarity of the content before showing the video to participants.

Post-Test Questionnaire. The Post-Test Questionnaire included the same questions that we presented prior to the video regarding the AAP back-to-sleep and

tummy-time recommendations, with the addition of two questions for participants to note what they liked and what they would change about the video. To reiterate, participants initially completed two questionnaires: (a) the Demographic and Personal Practices Questionnaire, followed by (b) the Pre-Test Questionnaire. After completing the Pre-Test Questionnaire, participants watched the video and then completed the Post-Test Questionnaire, which had questions identical to those from the Pre-Test Questionnaire.

Response measurement and inter-rater agreement. The questionnaires involved both multiple-choice and short-answer questions and were scored for accuracy. The primary experimenter scored short-answer questions by comparing participants' answers to a score sheet. The score sheet provided all possible correct answers. To ensure integrity of the primary experimenter's scoring, a second scorer independently scored 100% of all questionnaires. The intraclass correlation coefficient was .97 and .92 for the pre- and post-test questionnaires, respectively, suggesting excellent internal consistency between the two scorers.

Data analyses. The purpose of Experiment 1 was to determine if an experimenter-developed video was an effective tool to educate parents and expectant parents about safe sleep and tummy time, and to determine whether incoming knowledge about safe sleep and tummy time differed by participant group or was related to any other participant demographic characteristics. Therefore, we conducted a mixed design analysis of variance (ANOVA) to determine if caregivers' knowledge of the AAP's positioning recommendations improved from the Pre-Test (before the video) to the Post-Test Questionnaire (after the video) by comparing the mean number of correct items on the questionnaires. We also used paired-samples t-tests to determine if there were significant

differences in scores within the individual groups (e.g., if there was a statistically significant increase in scores at post-test for the High-SES Parent Group). We also conducted independent samples t-tests to examine the differences in knowledge between the parent and the expectant-parent groups (i.e., without regard to SES). We used descriptive statistics to analyze responses to questions on the Demographic and Personal Practices Questionnaire, as well as the Pre-and Post-Test Questionnaire. For the Pre- and Post-Test Questionnaire, we also used descriptive statistics to identify any differences in scores between groups by topic (safe sleep vs. tummy time) as well as in the overall scores. Next, we conducted regression analyses to determine if variance in scores at pre- and post-test were explained by individual and/or combined demographic variables. Finally, we conducted binary-logistic regressions to examine if any demographic variables predicted the position and location participants put or planned to put their infants for naps and sleep at night.

Results

Demographic and Personal Practices Questionnaire. Table 1 presents demographic information for parent type, weeks of gestation for expectant parents, and gender. More than half of participants (57.85%) were current mothers of a child three years of age or younger, and about one-quarter (26.45%) were women who were expecting their first child. Of those women who were expecting, most (80.96%) reported 20 to 23 weeks gestation or greater. A large majority (84.3%) of participants were female.

Table 1

Participants' Parent Type, Weeks Gestation of Pregnancy, and Gender

Variable	Response	Frequency	Percentage
Parent type[19] (*N* = 121)	Mother of young child	70	57.85%
	Pregnant with 1st child	32	26.45%
	Significant other is pregnant with 1st child	10	8.26%
	Father of young child	9	7.44%
Weeks gestation (*N* = 42)	20 to 23 weeks	9	21.43%
	24 to 27 weeks	7	16.67%
	36 to 39 weeks	7	16.67%
	32 to 35 weeks	6	14.29%
	28 to 31 weeks	5	11.90%
	12 to 15 weeks	3	7.14%
	Under 12 Weeks	3	7.14%
	16 to 19 weeks	2	4.76%
Gender (*N* =121)	Female	102	84.30%
	Male	19	15.70%

Table 2 presents marital status for all participants. About half (49.17%) of participants were married.

Table 2

Participants' Marital Statuses

Variable	Response	Frequency	Percentage
Marital status (*N* = 120)	Married	59	49.17%
	Living with significant other	32	26.67%
	Single	26	21.67%
	Separated or divorced	3	2.50%

[19] Other legal guardians (such as grandmothers or grandfathers) were invited to take part in the study but none participated. Other non-zeros are not provided in the tables to follow.

Table 3 presents the age ranges for all participants. About half (45.45%) of participants were between the ages of 25 and 34.

Table 3

Participants' Ages

Variable	Response	Frequency	Percentage
Age (N = 121)	25 to 34	55	45.45%
	18 to 24	34	28.10%
	35 to 44	22	18.18%
	13 to 17	8	6.61%
	45 to 54	2	1.65%

Table 4 presents the participants' income ranges. Approximately one-third (34.75%) of participants had an annual household income of less than $15,000. Slightly less than one-third (27.12%) of participants had an annual household income of more than $90,000.

Table 4

Participants' Annual Total Household Incomes

Variable	Response	Frequency	Percentage
Annual income (N = 118)	Less than $15,000	41	34.75%
	More than $90,000	32	27.12%
	$30,000 to $45,000	13	11.02%
	$45,000 to $60,000	9	7.63%
	$75,000 to $90,000	9	7.63%
	$60,000 to $75,000	7	5.93%
	$15,000 to $30,000	7	5.93%

Table 5 presents the insurance type for all participants. About half (47.11%) reported having private insurance, and about half (52.89%) reported having medical assistance or no insurance. To reiterate, those participants with private insurance we classified as either a "High-SES" parent or expectant parent, depending on their reported parent type. Those participants with medical assistance or no insurance we classified as either a "Low-SES" parent or expectant parent, depending on their reported parent type.[20]

Table 5

Participants' Insurance Types

Variable	Response	Frequency	Percentage
Insurance type ($N = 121$)	Medical Assistance	61	50.41%
	Private insurance	57	47.11%
	No insurance	3	2.48%

Table 6 presents the participants' reported highest level of education. Approximately one-third (32.23%) of participants had a graduate degree, whereas 20.66% did not graduate from high school.

[20] To further support use of insurance type as a measure of SES, we determined through chi-square tests of independence that there was a significant association between participants' insurance type and annual household incomes, $\chi^2(3, N = 121) = 81.61$, $p < .001$, as well as insurance type and education, $\chi^2(4, N = 121) = 55.83$, $p < .001$.

Table 6

Participants' Highest Level of Education

Variable	Response	Frequency	Percentage
Education (N = 121)	Graduate degree	39	32.23%
	Some high school but did not graduate	24	19.83%
	High school degree or equivalent (e.g., GED)	21	17.36%
	Some college or 2-year degree	18	14.88%
	4-year college graduate	15	12.40%
	More than 4 years of college	3	2.48%
	8th grade or less	1	0.83%

Table 7 presents the percentage of participants who reported currently working with children under 3, or having worked with children under 3 in the past. About one-third (33.88%) of participants reported working with children under 3. Participants reported working in a variety of professions, with participants most commonly reporting working as a childcare provider (19.51%), teacher (14.63%), or nanny (12.2%). Participants also listed "other" positions (17.07%), which included professions like, "social worker," "mental health therapist," and "behavior therapist."

Table 7

Participants Who Worked with Children Under 3 and Their Professions

Variable	Response	Frequency	Percentage
Work/worked with children under 3 ($N = 121$)	No	80	66.12%
	Yes	41	33.88%
Profession (if work/ed with children under 3) ($N = 41$)	Childcare provider	8	19.51%
	Other profession listed	7	17.07%
	Teacher	6	14.63%
	Nanny	5	12.20%
	> 1 position selected	4	9.76%
	Nurse	3	7.32%
	Special Education Teacher	3	7.32%
	Physician	2	4.88%
	Occupational Therapist	1	2.44%
	Psychologist	1	2.44%
	Service Coordinator/ Case Manager	1	2.44%

Table 8 depicts participants' reported races. Half (50.41%) of participants were White, and 39.67% were Black. For the purpose of our statistical analyses, given the small number of participants from other races, those who reported their race as "American Indian or Alaskan Native," "Asian or Pacific Islander," or "Hispanic or Latino," we grouped together as "Other Minority."

Table 8

Participants' Races

Variable	Response	Frequency	Percentage
Race ($N = 121$)	White or Caucasian	61	50.41%
	Black or African American	48	39.67%
	Hispanic or Latino	7	5.79%
	American Indian or Alaskan Native	2	1.65%
	Asian or Pacific Islander	2	1.65%
	More than 1 of the above races selected	1	0.83%

Table 9 depicts when participants reported receiving information about safe sleep, and from what source. Most participants (33.67%) reported receiving information about safe sleep during pregnancy, whereas 20% reported *never* receiving information. Of those 24 participants who reported never receiving information about safe sleep, all but two of them were first-time, expectant parents. Specifically, without regard to SES, 2.56% of parents (i.e., 2 out of 78) reported *never* receiving information about safe sleep, in contrast to 52.38% of expectant parents (i.e., 22 out of 42).

Of those participants who reported that they did receive information about safe sleep, the top sources they reported that provided the most information were the nurse at the hospital where their baby was born (17.71%; parents only), "other" (14.58%; e.g., through job or college classes), the Internet (12.50%), or parents and grandparents (11.46%).

Table 9

When Participants Received Information about Safe Sleep and from What Source

12[21]. When did you receive information regarding SAFE SLEEP? (*N* = 120)		
Response	**Frequency**	**Percentage**
During pregnancy	44	36.67%
Before pregnancy	30	25.00%
I never received info	24	20.00%
1st week of my child's life	11	9.17%
Received info but don't remember when	6	5.00%
1 week to 3 months old	4	3.33%
Older than 3 months	1	0.83%
If you received information about safe sleep, what source provided you with the most information regarding SAFE SLEEP? (*N* = 96)		
Nurse at hospital where baby was born	17	17.71%
Other	14	14.58%
Internet	12	12.50%
Parents or grandparents	11	11.46%
Books or print resources	10	10.42%
More than 1 option selected	10	10.42%
Pediatrician or family physician	9	9.38%
Obstetrician or nurse midwife	7	7.29%
Other family members	3	3.13%
Friends	2	2.08%
Television or DVDs	1	1.04%

Table 10 depicts when participants' reported receiving information about tummy time, and from what source. Most participants (28.33%) reported *never* receiving information about tummy time, followed by before pregnancy (20%), and during pregnancy (20%). Of those 34 participants who reported never receiving information about safe sleep, all but five participants were first-time, expectant parents. Specifically,

[21] This number (and subsequent numbers within tables) refers to the number of the item on the questionnaire.

6.41% of parents (5 out of 78) reported *never* receiving information about safe sleep, in contrast 69.05% of expectant parents (29 out of 42).

Of those participants who reported that they did receive information about tummy time, the top sources that provided the most information were the pediatrician or family physician (21.18%), "other" (15.29%; e.g., through job or college classes), the Internet (11.76%), or a nurse at hospital where baby was born (10.59%).

Table 10

When Participants Received Information about Tummy Time and from What Source

13. When did you receive information regarding <u>TUMMY TIME</u>? (*N* = 120)		
Response	**Frequency**	**Percentage**
I never received info	34	28.33%
Before pregnancy	24	20.00%
During pregnancy	24	20.00%
1 week to 3 months old	17	14.17%
1st week of my child's life	9	7.50%
Received info but don't remember when	7	5.83%
Older than 3 months	5	4.17%
If you received information about safe sleep, what source provided you with the <u>most</u> information regarding <u>TUMMY TIME</u>? (*N* = 85)		
Pediatrician or family physician	18	21.18%
Other	13	15.29%
Internet	10	11.76%
Nurse at hospital where my baby was born	9	10.59%
More than 1 option selected	8	9.41%
Other family members	8	9.41%
Books or print resources	6	7.06%
Parents or grandparents	5	5.88%
Friends	4	4.71%
Obstetrician or nurse midwife	3	3.53%
Television or DVDs	1	1.18%

Table 11 presents participants' top most valued sources for information about sleep. Most participants (40.35%) reported that the pediatrician or family physician was their most

valued source of information about positioning for sleep, followed by parents or grandparents (17.54%), and obstetrician or nurse midwife (15.79%). When looking at what sources participants ranked in as their top three sources, 72.41% of participants included the pediatrician or family physician in their top three, followed by nurse at hospital where baby was born (52.59%), parents or grandparents (37.93%), obstetrician or nurse midwife (37.93%), and the Internet or smartphone application (31.90%).

Table 11

Participants' Most Trusted Sources for Information about Sleep

14. Parents may receive information about positioning babies for SLEEP from a variety of sources. Please rank the THREE sources you value the most for information about positioning for SLEEP, with 1 being the most valued source, 2 being the second most valued source, and 3 being the third most valued source.

	Ranked as #1 Source ($N = 114$[22])		**Ranked in Top 3** ($N = 116$[23])	
Response	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Pediatrician or family physician	46	40.35%	84	72.41%
Parents or grandparents	20	17.54%	44	37.93%
Obstetrician or nurse midwife	18	15.79%	44	37.93%
Nurse at hospital where baby was born	15	13.16%	61	52.59%
Internet or smartphone application	6	5.26%	37	31.90%
Books or other print resources	7	6.14%	28	24.14%
Friends	1	0.88%	16	13.79%
Television or DVDs	1	0.88%	11	9.48%
Other family members	0	0.00%	18	15.52%

[22] For both Tables 11 and 12, one participant ranked two sources as his/her #1 source and another participant listed three top sources but did not rank them. As such, these two participants' responses were not included in the data for #1 sources, but were included in the data for the top three sources, which is why the N differs between the two columns in both tables.

[23] The total frequency of responses represented in this column is 343. Had the 116 participants who responded to this question ranked *three* sources, the total frequency of responses represented would have been 348. However, some participants only ranked one or two sources, which brought down the total frequency to 343.

Table 12 presents participants' top most valued sources for information about tummy time. As with information about sleep, most participants (44.64%) reported that the pediatrician or family physician was their most valued source of information about tummy time, followed by parents or grandparents (16.07%), and obstetrician or nurse midwife (13.39%). When looking at what sources participants ranked as their top three sources, 76.32% of participants included the pediatrician or family physician in their top three, followed by nurse at hospital where baby was born (51.75%), parents and grandparents (37.72%), obstetrician or nurse midwife (34.26%), and the Internet or smartphone application (34.21%).

Table 12

Participants' Most Trusted Sources for Information about Tummy Time

15. Parents may receive information about TUMMY TIME from a variety of sources. Please rank the THREE sources you value the most for information about TUMMY TIME, with 1 being the most valued source, 2 being the second most valued source, and 3 being the third most valued source.

	Ranked as #1 Source ($N = 112$)		**Ranked in Top 3** ($N = 114$[24])	
Response	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Pediatrician or family physician	50	44.64%	87	76.32%
Parents or grandparents	18	16.07%	43	37.72%
Obstetrician or nurse midwife	15	13.39%	37	32.46%
Nurse at hospital where baby was born	13	11.61%	59	51.75%
Internet or smartphone application	10	8.93%	39	34.21%
Books or other print resources	4	3.57%	26	22.81%
Friends	1	0.89%	20	17.54%
Other family members	1	0.89%	19	16.67%
Television or DVDs	0	0%	7	6.14%

[24] The total frequency of responses represented in this column is 337. Had the 114 participants who responded to this question ranked three sources, the total frequency of responses represented would have been 342. However, some participants only ranked one or two sources, which brought down the total frequency to 337.

Table 13 depicts the places that parents put or expectant parents planned to put their infants to sleep *for naps* from birth to 4 months of age, most of the time. Most participants reported putting or planning to put their infants to sleep in a crib (21.01%) or bassinet (19.33%). Cribs (or portable cribs), bassinets, and play yards (i.e., Pack N' Plays) are the only places that are safe for infant sleep, per the AAP (2016) recommendations. Thus, we categorized all responses by (a) safe, (b) unsafe (i.e., all locations other than a crib, bassinet, Pack N' Play), or (c) safe and unsafe (i.e., if multiple places selected, and at least one was safe and a least one was unsafe). For infants who spent time in a Neonatal Intensive Care Unit (NICU), if the participant listed "incubator" as "other," this response also counted as a safe location. Of the places participants reported putting or planning to put their infants to sleep, 50% of participants reported only safe places, 36.21% reported only unsafe places, and 13.79% reported both safe and unsafe places.

Table 13

Where Participants Placed or Planned to Place Their Infants for Naps

16. Expectant-Parent Group: WHERE do you *plan* to place your baby to sleep *FOR NAPS?* Parent Group: From birth to 4 months of age, WHERE did you place your baby to sleep *FOR NAPS*, most of the time? (*N* = 119)

Response/Category	Frequency	Percentage
In a crib	25	21.01%
Bassinet	23	19.33%
Multiple safe and unsafe options selected	16	13.45%
On my chest (e.g., held on chest or wrap/carrier)	11	9.24%
In a swing	7	5.88%
Wherever baby is most comfortable	7	5.88%
Multiple unsafe options selected (e.g., chest, bed)	6	5.04%
In an infant seat (e.g., vibrating seat, Rock N' Play)	5	4.20%
In Pack N' Play	5	4.20%
Multiple safe options selected (e.g., crib and bassinet)	4	3.36%
In my arms	3	2.52%
Not sure	3	2.52%
In a bed	2	1.68%
Other safe option listed (e.g., incubator in NICU)	1	0.84%
Other unsafe option listed (e.g., co-sleeper)	1	0.84%
Total (*N* = 116[25])		
Total safe	58	50.00%
Total unsafe	42	36.21%
Total safe and unsafe	16	13.79%

Table 14 depicts the places that parents put or expectant parents planned to put their infants to sleep *at night* from birth to 4 months of age, most of the time. Most participants reported putting or planning to put their infants to sleep in a crib (37.19%) or bassinet (28.93%). We categorized responses for sleep at night as "safe," "unsafe," and "safe and unsafe" for sleep at night in the same manner we coded them for naps. Of the places participants reported putting or planning to put their infants to sleep, 80% of

[25] For Tables 13, 14, 15, and 17, the responses of "not sure" are not included in the section summarizing safe vs. unsafe responses, which is why the N differs between the two sections of the table.

participants reported only safe places, 12.5% reported only unsafe places, and 7.5% reported both safe and unsafe places.

Table 14

Where Participants Placed or Planned to Place Their Infants for Sleep at Night

17. Expectant-Parent Group: WHERE do you *plan* to place your baby to sleep *AT NIGHT*? Parent Group: From birth to 4 months of age, WHERE did you place your baby to sleep *AT NIGHT*, most of the time? (*N* = 121)		
Response/Category	**Frequency**	**Percentage**
In a crib	45	37.19%
Bassinet	35	28.93%
In Pack N' Play	9	7.44%
Multiple safe and unsafe options selected	9	7.44%
Multiple safe options selected (e.g., crib, bassinet, and/or Pack N' Play)	6	4.96%
In a bed	4	3.31%
In an infant seat (e.g., vibrating seat, Rock N' Play)	3	2.48%
Multiple unsafe options selected (e.g., chest, bed)	3	2.48%
Wherever baby is most comfortable	2	1.65%
In my arms	1	0.83%
In a swing	1	0.83%
Not sure	1	0.83%
Other safe option listed (e.g., incubator)	1	0.83%
Other unsafe option listed (e.g., cosleeper)	1	0.83%
Total *(N= 120)*		
Total safe	96	80.00%
Total unsafe	15	12.50%
Total safe and unsafe	9	7.50%

Table 15 depicts the positions that parents put or expectant parents planned to put their infants to sleep *for naps* from birth to 4 months of age, most of the time. Most participants (62.81%) reported putting or planning to put their infants to sleep on their backs, 12.4% reported the tummy position, 8.26% reported the side position, and 4.96% reported whichever position baby was/is most comfortable. We categorized positioning on the back (or NICU positioning if infant spent time in the NICU) as "safe" and all other positioning as "unsafe." Thus, most participants (66.96%) reported only safe positioning,

26.96% reported only unsafe positioning, and 6.09% reported safe and unsafe positioning (e.g., back and side). These findings are concerning, as about one-third of participants positioned or planned to position their infants unsafely, at least some of the time.

Table 15

In What Position Participants Placed or Planned to Place Their Infants for Naps

18. Expectant-Parent Group: In what POSITION do you *plan* to place your baby to sleep *FOR NAPS*? Parent Group: From birth to 4 months of age, in what POSITION did you place your baby to sleep *FOR NAPS,* most of the time? (N = 121)		
Response	**Frequency**	**Percentage**
On back	76	62.81%
On tummy	15	12.40%
On side	10	8.26%
Safe and unsafe options selected (e.g., back and tummy, back and side)	7	5.79%
Whichever position most comfortable	6	4.96%
Not sure	6	4.96%
Other safe positioning (i.e., positioning in NICU)	1	0.83%
Total *(N= 115)*		
Total safe	77	66.96%
Total unsafe	31	26.96%
Total safe and unsafe	7	6.09%

Table 16 depicts participants' top reported reasons for the positions they selected for sleep *for naps.* Of those participants who reported placing or planning to place their infants in only the safe positions (i.e., back only or NICU positioning), we calculated the top reasons for these participants' placement. We then did the same for those participants who reported placing or planning to place their infants in only the unsafe positions (i.e., tummy, side, and/or whichever position baby is/was most comfortable). The top reason for placement on back and/or NICU positioning was "fear of SIDS" (40.26%), whereas the top reason for placement on tummy, side, and/or whichever position baby was/is most

comfortable was the "my baby liked/will like it best" (38.71%; 10 out of the 12 responses for this item were from parents).

Table 16

Top Reasons for Safe and Unsafe Positioning for Naps

19. What was your <u>main reason</u> for placing the baby in the position you noted above *FOR NAPS*?

Top five reasons participants reported selecting <u>safe</u> positions (back or NICU positioning; *N* = 71[26])		
Response	**Frequency**	**Percentage**
Fear of SIDS	31	40.26%
Fear of baby suffocating	20	25.97%
The doctor said to	9	11.69%
My baby liked it best	6	7.79%
Fear of baby choking	5	6.49%
Reasons[27] participants reported selecting <u>unsafe</u> positions (tummy, side, and/or whichever position most comfortable; *N* = 31)		
Response	**Frequency**	**Percentage**
My baby liked it best	12	38.71%
Fear of baby choking	5	16.13%
Position was easiest for me	4	12.90%
Parents or grandparents told me to	4	12.90%
Fear of SIDS	1	3.23%
Fear of choking and baby liked it best	1	3.23%
Fear of choking, suffocating, and other: "Gives neck support"	1	3.23%
Fear of choking and SIDS	1	3.23%
Other: "Just because"	1	3.23%
Other: "Flat head"	1	3.23%

Table 17 depicts the positions that parents put or expectant parents planned to put their infants to sleep for sleep *at night* from birth to 4 months of age, most of the time.

[26] These reasons for safe positioning in Tables 16 and 18 do not yield a total of 100% because these are the *top* reasons for positioning. That is, other less frequently reported responses are not included in these sections of the tables which make up the remainder of the reasons for positioning.

[27] In Tables 16 and 18, *all* reasons for unsafe positioning are listed—rather than the *top* five or six reasons—because of the large portion of responses associated with an N of only 1.

Most participants (76.86%) reported putting or planning to put their infants to sleep on their backs, 4.96% reported the tummy position, 2.48% reported the side position, and 5.79% reported whichever position baby was/is most comfortable. We categorized positions as "safe" and "unsafe" as we had done for naps. Thus, most participants (83.19%) reported only safe positioning, 15.04% reported only unsafe positioning, and 1.77% reported safe and unsafe positioning (e.g., back and side). Comparing sleep positioning for naps to positioning at night, more participants reported safer positioning at night (83.19%) compared to naps (66.96%).

Table 17

In What Position Participants Placed or Planned to Place Their Infants for Sleep at Night

20. Expectant-Parent Group: In what POSITION do you *plan* to place your baby for sleep *AT NIGHT*? Parent Group: From birth to 4 months of age, in what POSITION did you place your baby to sleep *AT NIGHT*, most of the time? (N = 121)		
Response	**Frequency**	**Percentage**
On back	93	76.86%
Not sure	8	6.61%
Whichever position most comfortable	7	5.79%
On tummy	6	4.96%
On side	3	2.48%
Safe and unsafe options selected (e.g., back and tummy, back and side)	2	1.65%
Other safe positioning (i.e., positioning in NICU)	1	0.83%
Multiple unsafe options selected (e.g., tummy and side, side and whichever position most comfortable)	1	0.83%
Total *(N= 113)*		
Total safe	94	83.19%
Total unsafe	17	15.04%
Total safe and unsafe	2	1.77%

Table 18 depicts participants' top reported reasons for the positions they selected for sleep for sleep *at night*. As with positioning for naps, the top reason for placement on back and/or NICU positioning at night was "fear of SIDS" (37.23%), whereas the top reason for placement on tummy, side, and/or whichever position baby was/is most comfortable was "my baby liked/will like it best" (52.94%; 7 out of the 9 responses for this item were from parents).

Table 18

Top Reasons for Safe and Unsafe Positioning for Sleep at Night

21. What was your <u>main reason</u> for placing the baby in the position you noted above for sleep *AT NIGHT*?

Top six[28] reasons participants reported selecting <u>safe</u> positions (back or NICU positioning; *N* = 79)		
Response	**Frequency**	**Percentage**
Fear of SIDS	35	37.23%
Fear of baby suffocating	20	27.28%
The doctor said to	9	9.57%
Parents or grandparents told me to	7	7.45%
Fear of baby choking	4	4.26%
Baby liked/will like it best	4	4.26%
Reasons participants reported selecting <u>unsafe</u> positions (tummy, side, and/or whichever position most comfortable; *N* = 17)		
Response	**Frequency**	**Percentage**
Baby liked/will like it best	9	52.94%
Fear of baby choking	4	23.53%
Fear of baby suffocating *and* baby liked it best	1	5.88%
Fear of baby choking, fear of baby suffocating, *and* "other" (reported "gives neck support")	1	5.88%
Fear of baby choking *and* SIDS	1	5.88%
Fear of SIDS	1	5.88%

[28] This table depicts the top six reasons for positioning (rather than the top five reasons, as in Table 16) because some responses participants reported with the same frequency.

Table 19 presents how much total time parents placed or expectant parents planned to place their infants on their tummies, while awake. Most participants (25.62%) placed or planned to place their infants on their tummies for 16 to 30 min per day.

Table 19

Total Amount of Tummy Time Participants Provided or Planned to Provide

22. Expectant-Parent Group: How much total time, each day, do you *plan* to place your baby on his/her tummy while awake? Parent Group: From birth to 4 months of age, how much total time did your baby spend on his/her tummy while awake, each day? (*N* =121)		
Response	**Frequency**	**Percentage**
16 to 30 minutes	31	25.62%
6 to 15 minutes	24	19.83%
Not sure	19	15.70%
1 to 5 minutes	20	16.53%
31 to 60 minutes	11	9.09%
1 to 2 hours	7	5.79%
More than 2 hours	4	3.31%
Less than 1 minute	4	3.31%
All of the time	1	0.83%

Table 20 depicts how likely participants reported that they would be to place their infants on their tummies, while awake (i.e., conduct tummy time), if their infants were to fuss or cry. Most participants (40.5%) reported that they would be somewhat likely to place their infants on their tummies if they were to cry. A total of 38.01% of participants reported that, should their babies fuss or cry while on their tummies, they would either be unlikely to (22.31%) or they *would not* put their infants on their tummies (15.70%). These results provide further evidence for the need for interventions to improve infants' tolerance of tummy time, as many parents may conduct tummy time for shorter durations (or not at all) if their infants fuss or cry while on their tummies.

Table 20

Likelihood of Conducting Tummy Time if Infants Cried

23. Both groups: How likely would you be to place your baby on his/her tummy if your baby were to cry or fuss while on his/her tummy, while awake? (N = 121)		
Response	**Frequency**	**Percentage**
Somewhat likely	49	40.50%
Unlikely	27	22.31%
Likely	20	16.53%
I would not place my baby on his/her tummy	19	15.70%
Very likely	6	4.96%

Table 21 depicts parents' responses to how their infants seemed to like being placed on their tummies and backs, while awake. Most participants reported that their infants either seemed to like being on their tummies (35.9%), in contrast to 50.63% of participants who reported that their infants seemed to like being on their backs. Collectively, more than half of participants (55.13%) reported that their infants disliked being on their tummies at least some of the time (i.e., 35.9% reported that they sometimes disliked it, 19.23% reported that they seemed to dislike it), in contrast to about one-third of participants (32.91%) who reported that their infants disliked being on their backs at least some of the time (i.e., 26.58% reported that they sometimes disliked it, 6.33% reported that they seemed to dislike it). That is, participants reported greater infant intolerance to being placed on their tummies, compared to being placed on their backs.

Table 21

How Infants Seemed to Like Tummy and Back, While Awake

24. Parent Group only: How did your baby like being placed on his/her TUMMY <u>while awake</u>? (*N* = 78)			**25. Parent Group only: How did your baby like being placed on his/her BACK <u>while awake</u>? (*N* = 79)**	
Response	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Seemed to like it	28	35.90%	40	50.63%
Sometimes liked it and sometimes disliked it	28	35.90%	21	26.58%
Seemed to dislike it (cried/resisted)	15	19.23%	5	6.33%
Seemed to neither like or dislike it	4	5.13%	11	13.92%
I cannot remember	3	3.85%	2	2.53%

Table 22 depicts parents' main reasons for worry, if applicable, about putting their infants on their tummies, while awake. Of those who reported worry (53.16% of all parents), most of these (47.62%) reported that they worried because their infants cried or were fussy on their tummies and did not seem to enjoy it. Notably, others reported a fear that their infant would suffocate (16.67%), a fear of sudden infant death syndrome (9.52%), or that they did not have the time (i.e., to conduct tummy time, 7.14%). A small percentage of participants (7.14%) reported other worries about conducting tummy time, such as a history of their baby having acid reflux or throwing up while on his/her tummy.

Table 22

Parents' Worries about Conducting Tummy Time

26. Parent Group only: Were you ever worried about putting your baby on his/her tummy while awake? If so, please select the <u>main reason</u> for your concern. Please skip if this does not apply to you. (N = 42)		
Response	**Frequency**	**Percentage**
My baby cried or was fussy while on tummy and did not seem to enjoy it	20	47.62%
Fear of baby suffocating	7	16.67%
Fear of sudden infant death syndrome	4	9.52%
More than 1 responses selected	4	9.52%
I did not have time	3	7.14%
Other	3	7.14%
My parents or grandparents told me not to put baby on tummy while awake	1	2.38%

Pre- and Post-Test Questionnaires. The following will describe the results of the pre- and post-test questionnaire, and address each hypothesis for Experiment 1. Appendix H presents a summary of the main analyses we conducted for Experiment 1, and the respective findings.

Effectiveness of the video (Hypothesis 1). Recall that in Hypothesis 1, we expected that the video would be associated with gains in caregiver knowledge about both safe sleep and tummy-time recommendations for both first-time, expectant parents and current parents. Figure 1 depicts the mean Pre- and Post- Test Questionnaire scores between each of the four groups. In Figure 1, the pre- and post-test are depicted along the *x*-axis and the mean percentage of correct items is depicted along the *y*-axis.

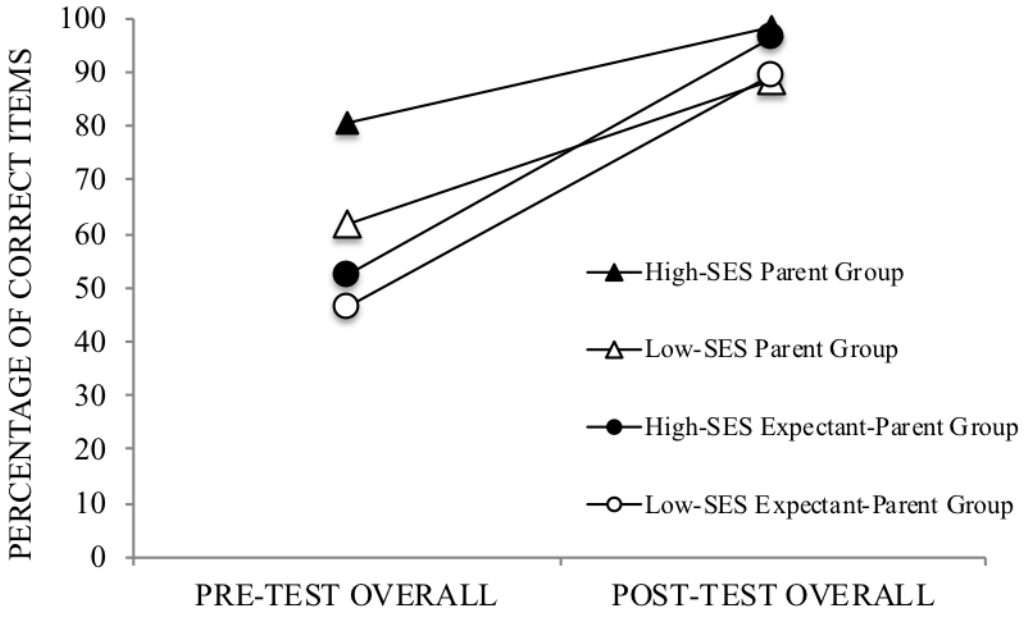


Figure 1. Percentage correct of the safe-sleep and tummy-time questions (all 10 items) on the Pre- and Post-Test Questionnaire. The solid horizontal lines depict statistically significant differences ($p < .01$) from pre- to post-test (i.e., all differences from pre- to post-test within individual groups were significant at $p < .001$).

The overall mean score at pre-test was 62.76% and 92.79% at post-test (difference of 30.03%), and results of a mixed-design ANOVA indicated a significant main effect for time, Wilks Lambda= .22, $F(3, 117) = 414.14$, $p < .001$, $\eta^2_{\text{partial}} = .78$. These results suggest that the video did play a causal role in increasing knowledge, and that the increase in scores from pre- to post-test was not attributed to simply experiencing the test on two occasions. Additionally, paired-samples t-tests indicated that there was an increase in knowledge from pre- to post-test for *all four groups*. Specifically, the High-

SES Parent mean was 80.66% at pre-test and 98.27% at post-test; $t(32) = -10.44$, $p < .001$. The Low-SES Parent mean was 61.71% at pre-test and 88.34% at post-test; $t(45), = -10.48$, $p < .001$. The High-SES Expectant Parent mean was 52.49% at pre-test and 96.3% at post-test; $t(23) = -9.08$, $p < .001$. Finally, the Low-SES Expectant Parent mean was 46.30% at pre-test and 89.43% at post-test; $t(17) = -13.03$, $p < .001$. Therefore, Hypothesis 1 was supported, as the video on safe sleep and tummy-time recommendations *was* associated with gains in caregiver knowledge.

Results of our mixed-design ANOVA indicated a significant interaction between time and group, Wilks Lambda= .71, $F(3, 117) = 15.89$, $p < .001$, $\eta^2_{\text{partial}} = .29$. Although all groups gained knowledge after watching the video, the gains were different across groups. The video was associated with the greatest increase in knowledge for both the High-SES Expectant Parent Group and the Low-SES Expectant-Parent Group (respective increase in scores at post-test by 43.81% and 43.13%). After watching the video, post-test scores were highest among the High-SES Parent Group (98.27%), followed by the High-SES Expectant Parent Group (96.30%), Low-SES Expectant Parent Group (89.43%), and the Low-SES Parent Group (88.34%).

We conducted an additional mixed-design ANOVA to examine the impact that the parent and insurance-type variables had on the interaction between time and group in our original mixed design ANOVA. When we split group into parent type and insurance type, the mixed design-ANOVA identified a significant interaction for parent type, $F(3, 117) = 43.88$, $p < .001$, $\eta^2 = .27$, *but not insurance type,* $F(3, 117) = 1.67$, $p = .198$, $\eta^2_{\text{partial}} = .01$. In other words, the effect of being a parent vs. expectant parent is what drove

the interaction between time and group, and *not* the participants' SES (as determined by insurance type).

Differences in incoming knowledge of safe sleep and tummy-time recommendations between all groups. We hypothesized that parents of children three and younger would have higher incoming knowledge (pre-test scores) than first-time expectant parents. Incoming knowledge (i.e., pre-test scores) *was* highest among both parent groups, relative to both expectant-parent groups. Results of the initial mixed-design ANOVA also indicated a significant effect for group, $F(3, 117) = 22.8$, $p < .001$, $\eta^2_{\text{partial}} = .37$. We conducted an independent samples t-test to compare any differences in incoming knowledge of safe sleep and tummy time between parents and expectant parents (without regard to SES). There was a significant difference in pre-test scores for the parents ($M = 69.63\%$) and the expectant parents ($M = 49.84\%$); $t(119) = 5.74$, $p < .001$. We conducted another independent samples t-test to determine if differences in knowledge between parents and expectant parents remained at post-test. Notably, there was not a difference in post-test scores for the parents ($M = 92.49\%$) and the expectant parents ($M = 93.36\%$); $t(119) = -.48$, $p = .633$.

Within groups, incoming knowledge was highest for those from high-SES backgrounds compared to low-SES backgrounds (High-SES Parent $M = 80.66\%$, Low-SES Parent $M = 61.71\%$, High-SES Expectant Parent $M = 52.49\%$, Low-SES Expectant Parent $M = 46.30\%$). Pairwise comparisons determined that there was a statistically-significant difference ($p < .001$) in the mean pre-test scores between the High-SES Parent Group and the (a) Low-SES Parent Group, (b) High-SES Expectant-Parent Group, and (c) Low-SES Expectant-Parent Group. There was also a statistically significant difference

between the Low-SES Parent Group ($p < .001$) and the Low-SES Expectant-Parent Group ($p = 0.006$).

It is important to note that our pairwise comparisons determined that, at post-test, there was no longer a statistically-significant difference in knowledge between some of the groups that were statistically different from one another at pre-test. Specially, at post-test, there was no longer a statistically-significant difference in mean post-test scores between the (a) High-SES Parent Group and the High-SES Expectant-Parent Group, and (b) Low-SES Parent Group and Low-SES Expectant Parent Group. In other words, the video helped close some of the gaps in knowledge that existed between some of the groups at pre-test. Although the mean scores were not statistically different from one another at pre-test, at post-test, there was a significant difference ($p = .002$) in the mean scores between the Low-SES Parent Group and the High-SES Expectant-Parent Group.

Differences in incoming knowledge of safe sleep between parents and expectant parents (Hypothesis 2). Table 23 depicts the mean Pre- and Post-Test Questionnaire scores between each of the groups, the overall mean scores, and the percent difference from pre- to post-test for only the items on the questionnaire related to safe sleep (i.e., 7 total items).

Table 23

Percentage of Correct Safe-Sleep Items on Pre- and Post-Test Questionnaire (7 Items)

Group	Pre-Test Safe-Sleep Items	Post-Test Safe-Sleep Items	
	Percentage Correct		Difference
High-SES Parent Group	86.05%	99.16%	13.11%
Low-SES Parent Group	75.24%	93.28%	18.04%
High-SES Expectant Parent Group	61.36%	97.70%	36.34%
Low-SES Expectant Parent Group	64.15%	93.63%	29.48%
Parents (High- and Low-SES)	79.76%	95.73%	15.97%
Expectant Parents (High and Low-SES)	62.55%	95.95%	33.40%
Mean for All Participants	**73.79%**	**95.81%**	**22.02%**

The overall mean score for the safe sleep items pre-test was 73.79% and 95.81% at post-test. A paired-samples t-test indicated that this increase in safe-sleep knowledge from pre- to post-test was significant, $t(120) = -12.84$, $p < .001$. The pattern for knowledge of safe sleep items is reflective of the pattern we observed for overall knowledge, in that incoming knowledge about safe sleep was highest among the two parent groups relative to the two expectant-parent groups. We conducted an independent samples t-test to compare any differences in incoming knowledge of safe sleep between parents and expectant parents (without regard to SES). There was a significant difference in pre-test scores for the parents ($M = 79.76\%$) and the expectant parents ($M = 62.55\%$); $t(119) = 5.41$, $p < .001$. Therefore, parents of children 3 years of age and younger *did* demonstrate greater knowledge of safe sleep at pre-test than first-time, expectant parents, and Hypothesis 2 was supported. Notably, as with overall scores, despite large differences in incoming knowledge at pre-test, the mean post-test scores for safe-sleep

items for the parents and expectant parents were not statistically significant from each other; parents (M = 95.73%) and the expectant parents (M = 95.95%); $t(119)$= -.16, p = .873. In other words, the video helped close the gaps in incoming knowledge about safe sleep between the parents and expectant parents.

When grouping parents and expectant parents by SES, incoming knowledge was higher in the High-SES Parent Group (86.05%) relative to the Low-SES Parent Group (75.24%), and slightly higher in the Low-SES Expectant Parent Group (64.15%) relative to the High-SES Expectant Parent Group (61.36%). After watching the video, post-test scores were highest in the High-SES Parent Group and High-SES Expectant Parent Group (99.16% and 97.70%, respectively) relative to the Low-SES Parent Group and the Low-SES Expectant Parent Group (93.28% and 93.63%, respectively). That is, as with the overall scores (mean of all 13 items) the video was associated with the greatest increase in knowledge about safe sleep for both the High-SES Expectant Parent and Low-SES Expectant Parent Groups (respective increase in scores at post-test by 36.34% and 29.48%).

Table 24 depicts how much participants reported to know about safe sleep on a scale of 1 to 10, as well as the mean percentage correct for each item related to safe sleep on the Pre- and Post-Test Questionnaire.

Table 24

Reported Safe-Sleep Knowledge and Percentage of Correct Items by Question

Question	Pre-Test Safe-Sleep Items	Post-Test Safe-Sleep Items	
	Reported Score from 1 to 10		**Difference**
1. How much do you think you know about SAFE SLEEP from a scale of 1 to 10?	6.70/10	9.24/10	2.54
	Percentage Correct		**Difference**
3. Which items/activities are recommended for SAFE SLEEP?	77.75%	92.31%	14.56%
4. Which items/activities are UNSAFE FOR SLEEP?	82.07%	94.53%	12.46%
5. *WHERE* would a <u>doctor</u> say a baby should sleep for *NAPS*	78.37%	95.53%	17.16%
6. *WHERE* would a <u>doctor</u> say a baby should sleep *AT NIGHT*	91.32%	99.04%	7.72%
7. *In what position* would a doctor say you should place your baby <u>to sleep</u> *FOR NAPS*	86.16%	99.17%	13.01%
8. *In what position* would a doctor say you should place your baby <u>to sleep</u> *AT NIGHT?*	85.95%	99.17%	13.22%
9. Do you know the "ABC's" of safe sleep? [If participant selected "yes"]: A stands for _____ B stands for _____ C stands for _____	14.88%	90.91%	76.03%
Mean for all safe-sleep items	**73.79%**	**95.81%**	**22.02%**

Participants' reported knowledge of safe sleep was 6.67/10 at pre-test and 9.24/10 at post-test. In addition to an increase in participants' subjective reported knowledge of safe sleep, on average, there was a demonstrable increase in knowledge for each of the safe-sleep questions. Notably, of all the unsafe items, participants most commonly

reported that they believed (a) crib bumpers, (b) blankets, and (c) pillows were safe for sleep. On average, participants' scored highest on, "Where would a doctor say a baby should sleep AT NIGHT?" (i.e., in a crib, 91.32%), and scored the lowest on the "ABCs" of safe sleep (i.e., Alone, on Back, and in a Crib, 14.88%) at pre-test. At post-test, the "ABCs" of safe sleep was associated with a 76.03% increase in scores.

Differences incoming knowledge of tummy time between parents and expectant parents (Hypothesis 3). Table 25 depicts the mean Pre- and Post- Test Questionnaire scores between each of the four groups, the overall mean scores, as well as the percentage difference from pre- to post-test for only the items on the questionnaire related to tummy time (i.e., three total items).

Table 25

Percentage of Correct Tummy-Time Items on Pre- and Post-Test Questionnaire (3 Items)

Group	Pre-Test Tummy Time Items	Post-Test Tummy Time Items	
	Percentage Correct		Difference
High-SES Parent Group	67.87%	95.96%	28.09%
Low-SES Parent Group	33.88%	76.81%	42.93%
High-SES Expectant Parent Group	35.42%	93.06%	57.64%
Low-SES Expectant Parent Group	9.72%	79.63%	69.91%
Parents (High- and Low-SES)	48.08%	84.81%	36.73%
Expectant Parents (High and Low-SES)	24.40%	87.30%	62.90%
Mean for All Participants	**39.86%**	**85.67%**	**45.81%**

The overall mean score for the tummy-time items pre-test was 39.86% and 85.67% at post-test. A paired-samples t-test indicated that this increase in tummy-time knowledge from pre- to post-test was significant, $t(120) = -14.98$, $p < .001$. As we did with overall knowledge and safe-sleep knowledge, we conducted an independent samples t-test to compare any differences in incoming knowledge of tummy time between parents and expectant parents (without regard to SES). There was a significant difference in pre-test scores for the parents ($M = 48.08\%$) and the expectant parents ($M = 24.4\%$); $t(119) = 3.76$, $p < .001$. That is, parents of children 3 years of age and younger *did* demonstrate greater knowledge of tummy time at pre-test than first-time, expectant parents. Thus, Hypothesis 3 was supported. Notably, as with overall knowledge and safe-sleep knowledge, despite large differences in incoming knowledge at pre-test, the mean post-test scores for tummy-time items for the parents and expectant parents were not statistically significant from each other; parents ($M = 84.81\%$) and the expectant parents ($M = 87.30\%$); $t(119) = -.67$, $p = .506$. That is, the video also helped close the gaps in incoming knowledge about tummy time between the parents and expectant parents.

When grouping parents and expectant parents by SES, incoming knowledge was higher in the High-SES Parent Group (67.87%) relative to the Low-SES Parent Group (33.88%), and higher in the High-SES Expectant Parent Group (35.42%) relative to the Low-SES Expectant-Parent Group (9.72%). After watching the video, post-test scores were highest in the High-SES Parent Group and High-SES Expectant Parent Group (95.96% and 93.06%, respectively) relative to the Low-SES Parent Group and the Low-SES Expectant-Parent Group (76.81% and 79.63%, respectively). Thus, the video was associated with a large percentage increase in scores from pre- to post-test for all groups.

In particular, as with safe-sleep knowledge, the High-SES Expectant Parent and Low-SES Expectant Parent Groups had the largest percentage increase in knowledge about tummy time (respective increase in scores at post-test by 57.64% and 69.91%).

Table 26 depicts how much participants reported knowing about tummy time on a scale of 1 to 10, as well as the mean percentage correct for each item related to tummy time on the Pre- and Post-Test Questionnaire.

Table 26

Reported Tummy-Time Knowledge and Percentage of Correct Items by Question

Question	Pre-Test Tummy-Time Items	Post-Test Tummy-Time Items	
	Reported Score from 1 to 10		**Difference**
2. How much do you think you know about TUMMY TIME from a scale of 1 to 10?	6.03/10	9.15/10	3.12
	Percentage Correct		**Difference**
10. Is it important for babies to have tummy time? [If participant selected "yes"], list two reasons why tummy time is important.	45.45%	78.51%	33.06%
11. How much tummy time does the American Academy of Pediatrics recommend that babies have each day?	38.84%	91.53%	52.69%
12. If a baby does not like tummy time (cries or fusses during tummy time), are there some things that a parent can do to help the baby enjoy tummy time? [If participant selected "yes'; list 2 things that might help a baby enjoy tummy time]	35.74%	86.98%	51.24%
Mean for all tummy-time items	**39.86%**	**85.67%**	**45.81%**

Participants' mean reported knowledge of tummy time was 6.03/10 at pre-test and 9.15/10 at post-test. In addition to an increase in participants' subjective reported knowledge of tummy time, on average, there was a demonstrable increase in knowledge for each of the tummy-time questions. For all three questions, average scores at pre-test for each question were below 50%.

Knowledge of safe-sleep recommendations and demographic characteristics (Hypothesis 4). We conducted a multiple regression to examine the effect of the demographic variables on incoming knowledge about safe sleep. Given the small number of responses for some categories for the age, income, and the education variables, categories with a smaller number of participants were combined. For instance, as there were only three participants who reported that they were "separated or divorced," we combined these participants with the "single" group.

Appendix I presents the regression coefficients for the model. There was a significant main effect for parent type, $F(1,101) = 24.93$, $p < .001$, $\eta^2_{\text{partial}} = .20$ and gender, $F(1,101) = 17.30$, $p < .001$, $\eta^2_{\text{partial}} = .15$. That is, parents' incoming safe-sleep knowledge was significantly higher than that of the first time, expectant parents, and females' incoming safe-sleep knowledge was significantly higher than that of males.

Based on the literature, we expected that participants from low-SES backgrounds would have less incoming knowledge about safe sleep, relative to caregivers from high-SES backgrounds. When looking at just the mean scores within groups (i.e., High-SES Parents compared to Low-SES Parents and High-SES Expectant Parents compared to Low-SES Expectant Parents), we did see differences in safe-sleep knowledge by SES.

However, there was not a significant main effect for SES (i.e., insurance type) when entered into the multiple regression model. Thus, Hypothesis 4 was not supported.

Knowledge of tummy-time recommendations and demographic characteristics (Hypothesis 5). We conducted another multiple regression to examine the effect of the demographic variables on incoming knowledge about tummy time. Appendix J presents the regression coefficients for the model. When conducting the analysis on just incoming tummy-time knowledge, we saw the same effect that we did with safe-sleep knowledge in that the only significant main effects were for parent type, $F(1,101) = 15.82$, $p < .001$, $\eta^2_{partial} = .14$, and gender, $F(1,101)= 21.54$, $p < .001$, $\eta^2_{partial} = .18$. All other remaining demographic variables were not significant. Specifically, parents' incoming tummy-time knowledge was significantly higher than that of the first time, expectant parents, and females' incoming tummy-time knowledge was significantly higher than that of males. As with incoming safe-sleep knowledge, we expected that participants from low-SES backgrounds would have less incoming knowledge about tummy time, relative to caregivers from high-SES backgrounds. When looking at just the mean scores within groups (i.e., High-SES Parents compared to Low-SES Parents, and High-SES Expectant Parents compared to Low-SES Expectant Parents), we did see differences in tummy-time knowledge by SES. However, there was not a significant effect for SES (i.e., insurance type) when entered into the multiple regression model. Thus, Hypothesis 5 was not supported.

Additional exploratory analyses.

Relationship between demographic variables and overall incoming knowledge. We conducted an additional multiple regression to examine the effect of the demographic

variables on *overall* incoming knowledge. Appendix K presents the regression coefficients for the model. As we found with incoming knowledge about (a) safe sleep and (b) tummy time, in examining *overall* knowledge we found a significant main effect for parent type, $F(1,101) = 41.14$, $p < .001$, $\eta^2_{partial} = .29$, and gender, $F(1,101) = 35.05$ $p < .001$, $\eta^2_{partial} = .26$. Specifically, as noted in previous analyses, parents' incoming knowledge was higher ($M = 69.63\%$) than that of expectant parents ($M = 49.84\%$). Additionally, females' incoming knowledge was higher ($M = 66.12\%$) than that of males ($M = 44.70\%$). However, unlike the two previously reported regression analyses, we also identified an additional main effect of race, $F(2,101) = 3.62$, $p = .030$, $\eta^2_{partial} = .07$. That is, those participants who were White/Caucasian had higher incoming knowledge ($M = 68.56\%$) than those who were Black/African American ($M = 56.86\%$) or another other minority ($M = 56.88\%$).

As researchers suggest that the disparities in education, SES, and access to healthcare among caregivers from minority backgrounds may explain the disparities in the incidence of SIDS, as well as knowledge and implementation of safe sleep (e.g., Colson et al., 2005; Wise, 2003), we conducted the regression again, controlling for the variables of education, income, and insurance type. When we entered education, income, and insurance type as covariates in the model, there continued to be a main effect for race, $F(2,101) = 4.41$, $p = .014$, $\eta^2_{partial} = .08$, as well as parent type, $F(1,101) = 40.63$, $p < .001$, $\eta^2_{partial} = .28$, and gender, $F(1,101) = 38.99$, $p < .001$, $\eta^2_{partial} = .27$. In other words, parent type, gender, and race predicted overall incoming knowledge above and beyond education, income, and insurance type.

Relationship between demographic variables and position and location for sleep. We also conducted four binary-logistic regressions to examine relationships between any of the demographic variables[29] and: (a) position for naps, (b) position for nighttime sleep, (c) place for naps, and (d) place for nighttime sleep. Appendix L-O include the parameter estimates for the binary-logistic regressions. For the binary-logistic regressions examining *position* for naps and sleep at night, we compared those participants who reported that they placed (parents) or planned to place (expectant parents) their infants in at least one unsafe position (i.e., on their tummy, side, and/or whichever position they were most comfortable) to those participants who reported only safe positioning (i.e., on back). For the binary logistic regressions examining *location* for naps and sleep at night, we compared those participants who reported they placed or planned to place their infants in at least one unsafe location (e.g., swing, bed) to those participants who reported only safe locations (i.e., crib, bassinet, and/or Pack N' Play).

With respect to *position* for naps, age, education, and race were significant predictors of positioning. Appendix L presents the parameter estimates for the model examining position for naps. Compared to participants who were 35 or older, participants who were 13 to 24 years old were 19.88 times more likely to position or plan to position their infants unsafely, whereas participants who were 25 to 34 years old were 5.82 times more likely to position or plan to position their infants unsafely. Additionally, compared

[29] To ensure that there were a sufficient number of responses in each cell to conduct the analysis, we combined some subgroups that had relatively few responses. For example, we combined those who reported that they were 13 to 17 years of age with those who reported they were 18 to 24 years of age (i.e., the new sub-group included participants 13 to 24 years of age). We also combined all minority races together (i.e., the new sub-group included participants who were American Indian or Alaskan Natives, Asian or Pacific Islanders, Black or African American, and Hispanic or Latino).

to participants who had a graduate degree, participants who had less than a high-school diploma were 13.65 times more like to position or plan to position their infants unsafely. Lastly, compared to participants who were White or Caucasian, participants from any minority background were 3.65 times more likely to position or plan to position their infants unsafely. Despite findings these significant predictors of positioning for naps, no demographic variables significantly predicted positioning for sleep at night. Appendix M presents the parameter estimates for the model examining position for sleep at night.

With respect to *location* for naps, age, education, and race were significant predictors of the location participants reported placing or planning to place their infants. Appendix N presents the parameter estimates for the model examining location for naps. Specifically, compared to participants who were 35 or older, participants who were 13 to 24 years old were 10.17 times more likely to place or plan to place their infants in an unsafe sleep location for naps. Also, compared to participants who had less than a high-school diploma or GED, participants who had a high school diploma or GED were 0.10 times less likely to place or plan to place their infants in an unsafe location for naps. Finally, compared to participants who were White or Caucasian, participants from minority backgrounds were 0.31 times *less* likely to place or plan to place their infants in an unsafe location. That is, compared to participants who were White or Caucasian, we identified in the previously reported model that participants from minority backgrounds were *more likely to position their infants unsafely*, but in this model we identified that they were *less likely to place their infants in an unsafe location*. Unlike the model for location for naps, age—but not race or education—was also a significant predictor of location for sleep *at night*. Appendix O presents the parameter estimates for the model

examining location for sleep at night. Specifically, compared to participants who were 35 or older, participants who were 13 to 24 years of age were 37.94 times more likely to place or plan to place their infants in an unsafe location at night.

Discussion

Our primary aims for Experiment 1 were to (a) evaluate the effectiveness of a new video on increasing parents' and expectant parents' knowledge of safe sleep and tummy time and (b) determine if any demographic variables were associated with incoming knowledge of safe sleep and tummy time. A secondary aim was to better understand parents' practices and expectant parents' planned practices of safe sleep and tummy time with their infants, including sources of information of and reasons for their positioning practices. Previous research has shown that caregivers from minority, low-income, and low-education backgrounds are more likely to place infants in the prone position for sleep (e.g., Brenner et al., 1998; Willinger, Ko, Hoffman, Kessler, & Corwin, 2000), and that caregivers' perception of greater infant comfort, sleep quality, and safety are factors associated with their positioning of infants in the prone position for sleep. Our Experiment 1 findings add to the existing literature base by identifying that caregivers who were first-time expectant parents, male, or who came from minority backgrounds had lower overall incoming knowledge about safe-sleep and tummy-time, even when controlling for income, education, and type of insurance. Additionally, we identified that positioning and location for sleep may be associated with age, education, and race. A notable contribution of Experiment 1 is the identification of greater unsafe sleep practices for naps, compared to sleep at night. The extant studies have generally not asked parents

about sleep practices for naps vs. at night, and our Experiment 1 findings suggests that such specification may be critical.

Effectiveness of the video and sleep practices. The results of Experiment 1 showed that the video was an effective tool to educate parents and expectant parents about safe sleep and tummy time, as there was a significant difference in scores from pre- to post-test. Additionally, there was a significant increase in scores for all four groups. What is also promising about the results from Experiment 1 is that despite statistically significant differences in knowledge at pre-test between some of the groups, at post-test, there was no longer a statistically significant difference between some of the group's scores (e.g., between the parents and expectant parents). In other words, despite life circumstances that might impact one's incoming knowledge about safe sleep and tummy time due to either (a) lack of parenting experience (i.e., expecting a first baby) or (b) potential socioeconomic disadvantages (i.e., coming from a low-SES background), these circumstances did not prevent these participants from leaving with about the same knowledge as their more experienced and higher-SES counterparts (i.e., parents of children three and under and participants from higher-SES backgrounds). As such, Experiment 1 demonstrated that the video we created specifically for this study could be a beneficial educational tool for current parents *and* those expecting a first baby, whether they come from high- *or* low-SES backgrounds.

Demographic characteristics associated with incoming knowledge, and location and position for sleep. The literature is devoid of studies that have examined the relationship between parents' knowledge of the AAP's safe-sleep and tummy-time recommendations and demographic characteristics. As previously noted, studies have

found that caregivers from low-SES and minority backgrounds are more likely to place infants in prone for sleep (e.g., Brenner et al., 1998; Pollack & Frohna, 2002; Willinger et al., 2000). The results of our binary-logistic regressions suggest that practitioners should place particular emphasis on providing safe sleep education to young parents and expectant parents who come from low-education and minority backgrounds.

With respect to incoming knowledge, participants from high-SES backgrounds had higher incoming knowledge than participants from low-SES backgrounds. That being said, the only demographic variables that were significantly associated with incoming knowledge about safe sleep and tummy time were parent type (parent vs. expecting parent) and gender. When examining *overall* knowledge, however, parent type, gender, *and* race were significant predictors of incoming knowledge, even when controlling for income, education, and insurance type. It is unclear why race continued to be a significant predictor of overall incoming knowledge about safe sleep and tummy time, even when controlling for these variables associated with education and SES. The effect of race on incoming knowledge may be driven by variables highly correlated with race and which we did not measure in the study. For instance, Brenner and colleagues (1998) found in their sample of predominantly Black mothers that having a grandmother in the home independently predicted placing the infant in prone for sleep. We conducted additional analyses to explore the relationship between race and incoming knowledge (e.g., chi-square tests of independence to examine the relationship between race and most trusted sources of information about safe sleep and tummy time) but these results were not significant. Additional research warranted to further explore factors associated with

knowledge about and practice of safe sleep and tummy time, so as to best guide educational efforts.

Differences in knowledge of safe sleep vs. tummy time. We found that participants were far less knowledgeable about tummy time, compared to safe sleep. This finding manifested in a few ways: (a) mean reported knowledge about safe sleep was slightly higher (M = 6.7/10) than tummy time (M = 6.03/10) (b) the mean score for the safe-sleep items at pre-test was 73.79%, compared to 39.86% for tummy time, and (c) 20% of participants reported never receiving information about safe sleep, compared to 28.33% of participants who reported never receiving information about tummy time. These results are not surprising, given research that has found that healthcare providers do not have time to discuss tummy time with their patients (Koren et al., 2010). The emphasis on positioning for sleep rather than play is expected, as unsafe positioning for sleep can have fatal consequences. Although participants had greater knowledge of safe sleep compared to tummy time, our results indicated that participants' knowledge of both topics was deficient among all groups, and suggests that education—in particular, early education during pregnancy—is warranted to help ensure that parents are knowledgeable about safe sleep and tummy time.

Need for early education on safe sleep. Another notable finding from Experiment 1 is that, on aggregate, 20% of participants reported never receiving information about safe sleep. Only 2.56% of the parents (i.e., 2 of 78) reported *never* receiving information about safe sleep, in contrast to 52.38% of expectant parents (i.e., 22 of 42). Most participants reported receiving information either before (25% of participants) or during pregnancy (36.67% of participants). What is concerning is that

approximately 13% of our sample did not receive information about safe sleep until after their infant was born (i.e., 9.17% during first week of life, 3.33% during first week to 3 months of age, 0.83% after 3 months of age). Most participants (17.71%) reported receiving the most information about safe sleep from the nurse at the hospital where their baby was born. Another 9.38% received the most information from their pediatrician or family physician. The AAP recommends the first well-child visit at 2 to 5 days after birth (AAP, 2017b); even though this is a very short period of time between birth and the first visit to the pediatrician, the delay to provision of safe-sleep education until this time point may result in caregiver practices that put an infant at risk for SUID during those first days of life.

As noted by Moon, Hauck, and Colson (2016), nursing staff in hospitals often provide much of parents' initial safe-sleep education. However, although some may assume that safe-sleep education is timely as long as the expectant parents receive information about safe sleep *by day that their infants are born* (e.g., in the hospital from a nurse or doctor), even the timing of education in the hospital setting on the day of birth may be too late. That is, many expectant parents likely have determined where the baby will be sleeping (e.g., bassinet, crib, in bed with parents) well *before* the infant's birth. As the AAP (2016) recommends that caregivers use only "a crib, bassinet, portable crib, or play yard that conforms to the safety standards of the Consumer Product Safety Commission (CPSC)" (p. 4), expectant parents should be informed of these and other sleep-environment recommendations well before the infant is born so that they can adequately prepare for their infants to sleep safely from the day of birth. Such preparation may involve (a) acquiring a safe-sleep surface (e.g., a bassinet), (b) determining a

location for the safe-sleep surface to be placed in the parent's room (per AAP, 2016), (c) making sure that there are no suffocation hazards (e.g., crib bumpers) in the sleep space, (d) becoming educated about other practices associated with maternal and infant health (e.g., breastfeeding, avoiding smoke exposure), including a reduction in SIDS and (e) taking appropriate action (e.g., quitting smoking), if necessary. Additionally, for those expectant parents who cannot afford a crib or another safe-sleep surface, early timing of education in one's pregnancy would allow the expecting parents time to identify local community resources that may offer a crib at a free or reduced cost (e.g., Cribs for Kids®, Healthcare Access Maryland).

As 7.29% of our sample reported receiving the most information about safe sleep from their obstetrician or nurse midwife, our data suggest that *some* prenatal education *did* take place among our sample. Nevertheless, to help ensure that parents implement safe sleep with their infants, research suggests that educational interventions may be most effective when delivered prenatally and continued postnally, as parents' intentions during pregnancy may not match their actual behavior following their infants' birth (e.g., Hauck, Tanabe, McMurry, & Moon, 2015). Thus, early, repeated messages about safe sleep may be critical to helping ensure infant well-being. These early, repeated messages are not only vital to educating parents about safe sleep, but also tummy time.

Need for early education on tummy time. With respect to tummy time, on aggregate, 28.33% of participants reported never receiving information about tummy time. Not taking insurance type into consideration, 6.41% of parents reported never receiving information about tummy time, compared to 69.05% of expectant parents. These findings are in contrast to those reported by Zachry and Kitzmann (2011), who

found that approximately 66% of their sample of parents reported being aware of tummy time (in contrast to 6.41% of our parents). One plausible reason for the disparate results in awareness of tummy time between our study and that of Zachry and Kitzmann could be the timing of each study. That is, Zachry and Kitzmann collected their data between 2005 and 2006, before the publication of the AAP's "Back to Sleep, Tummy to Play" pamphlet in 2008. As our data were collected between 2016 and 2017, the public's awareness of tummy time since the publication of the AAP pamphlet and other publications (e.g., AAP, 2012, 2016) has likely increased, and was reflected in our data.

Most participants reported that their pediatrician or family physician was their *most valued source of information* about tummy time (44.64% of participants), and similar to the Zachry and Kitzmann (2011) study, pediatricians or family physicians were a top source for providing the *most information* on tummy time (i.e., 21.18% of participants in our study). Approximately 25% of our sample reported receiving information about tummy time *after their infant's birth* (i.e., 7.50% during first week of life, 14.17% during first week and 3 months of age, 4.17% after 3 months of age). As tummy time is recommended the day the infant comes home from the hospital, the timing of education for some of the parents in our sample was, in fact, too late.

As Zachry and Kitzmann (2011) note, "an optimal time to educate caregivers on the importance of tummy time would be before the parent and the infant leave the hospital" (p. 104). The authors also suggest that nurses and physicians provide information about tummy time during prenatal appointments. Although Zachry and Kitzmann did not ask participants about when they may have received information about tummy time, 40% of our participants reported receiving information about tummy time

either before (20%) or during pregnancy (20%). Only 3.53% of participants reported that their obstetricians and nurse midwives provided the *most information* about tummy time. As with safe-sleep education, ideally, *all* participants would receive education about tummy time early in pregnancy, and receive repeated messages about the importance of tummy time until well after the infant's birth.

Location and position for sleep. Another notable finding was that only 50% of participants reported safe-sleep locations (i.e., crib, bassinet, or Pack N' Play) for naps, compared to 80% for nighttime sleep. For sleep position, only 66.96% of participants reported safe-sleep positioning (i.e., back only or NICU positioning) for naps, compared to 83.19% for nighttime sleep. Researchers generally have not specified sleep for naps vs. for nighttime sleep when asking parents about sleep position or location, or only ask about nighttime sleep. For example, in the National Infant Sleep Position Study (NISP), researchers asked, "Sleep location: I am going to read a list of places where infants often sleep. After I finish reading the list, please tell me where the infant usually slept at night during the past 2 weeks" or "Sleep surface: please check all the places your baby has slept, over the last two weeks" (e.g., Colson et al., 2013). Given that we found a higher incidence of unsafe sleep positions and locations for naps compared to nighttime sleep, the unsafe positions and places parents use for sleep may be underrepresented in the literature, given the focus on nighttime sleep or the lack of specificity of time of day. Batra and colleagues (2016) found that 28% of 1-month old infants slept in at least two locations during the night, with 91% of those locations being an unsafe sleep surface (e.g., parent's bed, swing, sofa). Batra and colleagues noted,

> It is possible that well-intentioned parents consider safe sleep guidelines to be those that are applicable for the onset of sleep but less so in the middle of the night. It is therefore prudent for health care providers to ask about sleep environment for the entire night and provide anticipatory guidance accordingly. (p. 6)

It is possible that the participants in our study also considered safe-sleep guidelines to be more applicable to sleep at night, rather than sleep for naps. This possibility is supported by the Pre-Test Questionnaire data, as 78.37% of participants correctly identified "in a crib" as the place a doctor would say a baby should sleep for naps, compared to 91.32% of participants who identified "in a crib" for sleep at night. Interestingly, there was not a difference in the percentage of participants who correctly identified at pre-test *that a doctor would say* a baby should sleep on his/her back for naps vs. sleep at night (i.e., 86.16% answered correctly about sleep location for naps, 85.95% answered correctly about sleep location at night). Thus, in light of Batra and colleague's recommendation, the results of our Experiment 1 would also suggest that providers ask parents about the sleep environment not only for the entire night, but for *all sleep*, as participants were more likely to report unsafe sleep for naps than at night.

Our finding of the greater incidence of unsafe sleeping at naps compared to nighttime sleep has implications for research and practice. That is, this finding suggests that healthcare practitioners and researchers specifically ask parents about where and in what position their infant sleeps for naps and at night, as parents may respond with the location and position for just sleep at night. Additionally, this finding has implications for

practice in that it suggests that safe-sleep educational efforts should place emphasis on safe sleep *for all sleep*, and not just at night.

It should also be noted that, whereas 13.45% of our sample selected multiple options for naps that included both safe (e.g., in a crib) and unsafe (e.g., in a swing) options, the most common single response was "on my chest (either being held on chest or in infant wrap/carrier," accounting for 9.24% of responses for naps. We did not have an option listed to specify "on my chest (either being held or in infant wrap/carrier) *while I am awake*" or "in my arms *while I am awake*." Although the AAP recommends that parents use cribs, bassinets, or play yards for sleep, clearer guidance is needed regarding whether or not it is unsafe for an infant to sleep while held in a caregiver's arms or on his/her chest, while the caregiver is awake (and alert) and the infant's airway is clear (i.e., chin is not touching chest). Nevertheless, because we did not have an option for participants to specify the exact circumstances of their infants sleeping in their arms or on their chests, we elected to be conservative in our categorization of these responses and deemed them to be "unsafe." Future research should investigate the positions and places that caregivers use for infant sleep (a) at different times of the day (e.g., naps vs. nighttime) and (b) the environmental conditions associated with sleep. To reiterate, we had an option of "in my arms" or "on my chest," but there could have several contextual factors associated with these locations (e.g., on caregiver's chest *while caregiver is asleep on sofa* or being worn in a baby carrier *while caregiver is awake*), and these factors could be associated with greatly disparate risks for SUID. As one example, Blair et al. (1999) examined the risk of infant death by comparing the sleeping environments of 325 babies who died to that of 1,300 control infants, and found an extremely high risk of

death associated with sharing a sofa with a parent (odds ratio of 48.99; range of 5.04 to 475.60), compared to sharing a bed with a parent (odds ratio of 9.78; range of 4.02 to 23.83). Additionally, the AAP (2016) noted that,

> Sleeping on couches and armchairs places infants at extraordinarily high risk of infant death, including SIDS, suffocation through entrapment or wedging between seat cushions, or overlay if another person is also sharing this surface. Therefore, parents and caregivers should be especially vigilant as to their wakefulness when feeding infants or lying with infants on these surfaces. (p. 5)

Thus, more specific descriptions of the environmental conditions under which infants may sleep—as well as the times of the day associated with certain sleeping conditions—is warranted to further understand the prevalence of unsafe sleeping and the factors that may place infants at increased risk of SUID.

Reasons for positioning for sleep. Our findings for reasons parents placed or expectant parents planned to place their infants for sleep were extremely informative. Of those participants who reported safe positioning (i.e., back only or NICU positioning), participants' top two reasons were: (a) fear of SIDS and (b) fear of baby suffocating. Of those participants who reported unsafe positioning (i.e., any positioning other than back only or NICU positioning), the top two reasons were: (a) my baby liked/will like it best and (b) fear of baby choking. These findings are in line with other research on caregivers' reasons for positioning their infants for sleep. For example, in the National Infant Sleep Position Study (NISP), Willinger and colleagues (2000) found that caregivers were 20 times more likely to report "SIDS, crib death, SIDS report, or safest" as a reason for supine or lateral (side) positioning compared to caregivers who placed their infants in the

prone position. Additionally, of caregivers who placed their infants in prone for sleep, 82% reported doing so because "the baby likes it better and/or sleeps better that way." In the study by Willinger and colleagues, caregivers were also more likely to report placement of the infant in the lateral (side) position[30] or prone compared to supine, because of a fear of "vomiting, choking, or spitting up." As the AAP (2016) recently noted in their policy statement, "The supine sleep position does not increase the risk of choking and aspiration in infants, even those with gastroesophageal reflux, because infants have airway anatomy and mechanisms that protect against aspiration" (p. 3). The Safe to Sleep campaign has even developed images of infant anatomy to help educate caregivers by demonstrating that infants may be *less* likely to choke while on their backs, compared to when they are on their stomachs (Safe to Sleep Campaign, no date). Our results, coupled with that of Willinger and colleagues, suggests that parents may be in need of additional support to help their infants sleep on their backs, given the frequency with which infant behavior is cited as a reason for unsafe positioning. Additionally, given the confusion about the risk of choking in prone vs. supine, our results suggest that educational efforts help ensure that caregivers are aware that the supine position for sleep is the safest, even for infants with reflux.

We also found that a subset of those participants who *knew* that a doctor would say that infants should sleep on their backs (e.g., responded correctly to, "In what position would a doctor say a baby should sleep for naps?"), reported unsafe positioning for sleep. A total of 18.18% of participants who reported that a doctor would say that

[30] At the time of the Willinger et al. (2000) publication, the AAP recognized side sleeping as an alternative to supine sleeping. It was not until 2005 that the AAP recommended only the supine position for sleep.

infants should sleep on their backs for naps reported that they placed or planned to place their infants on their tummies, sides, or in whichever position they were most comfortable. This was the case for fewer participants for nighttime sleep; 8.26% of participants who reported that a doctor would say that infants should sleep on their backs at night reported unsafe positioning. In other words, they *knew* what a doctor would recommend as a safe-sleep practice, but their actual behavior (parents) or planned behavior (expectant parents) was unsafe. That being said, it is possible that the parents who reported unsafe positioning of their infants learned about safe positioning *after* their infant was older than 4 months, hence the discordance between responses to the two questions. Nevertheless, our results suggest that although education on safe sleep is extremely important, barriers to safe sleep may strongly influence caregivers' practices with their infants. Our results and that of others (e.g., Willinger et al., 2000), suggest that the baby's behavior—whether it be greater perceived comfort, less crying, or longer sleep duration—is the primary determinant of unsafe-sleep positioning. One limitation of this study is that we did not ask participants their reasons for the *locations* they placed or planned to place their infants for sleep. To help develop interventions to address unsafe-sleep practices, future research should be sure to investigate caregivers' reasons for the positions and locations they use for infant sleep for naps and nighttime sleep. In addition to providing education so that caregivers are knowledgeable about safe sleep, clearly, there needs to be greater emphasis on providing *support* to caregivers to help ensure that their infants sleep soundly *and* safely.

Infant intolerance of tummy time and caregiver behavior. Another clear theme with respect to infant behavior—infant intolerance of tummy time—emerged from

our results. First, more than half of participants (55.13%) reported that their infants disliked being on their tummies, at least some of the time. Specifically, 35.9% of participants reported that their infants sometimes disliked it, and 19.23% reported that their infants seemed to dislike it. In contrast, 32.91% of participants reported that their infants disliked being on their backs, at least some of the time. Second, infant intolerance of tummy time affected participants' practice or planned practice of tummy time with their infants. That is, participants reported that they would either be unlikely to put their infants on their tummies (22.31%) or would not put their infants on their tummies while awake (15.70%), if their infants were to fuss or cry. Only 4.96% of participants reported that they would be very likely to conduct tummy time if their baby were to fuss or cry while on his/her tummy. Third, 47.62% of parents reported that they were worried about putting their infants on their tummies while awake because "my baby cried or was fussy while on tummy and did not seem to enjoy it." These results are in line with research by Zachry and Kitzmann (2011), who found that only 47% of their participants reported that their infants seemed to tolerate tummy time (i.e., did not cry or resist being placed on tummy). Caregivers may terminate tummy time if the infant cries or fusses, or avoid placing the infant in prone altogether. Infant intolerance of tummy time may then impact the amount of tummy time that infants receive each day, which may then have adverse effects on infant development.

With respect to daily amount of tummy time caregivers may provide, 65.29% of participants reported providing or planning to provide 30 min or less of daily tummy time. Similarly, Zachry and Kitzmann (2011) reported in that a total of 53.2% of their participants reported providing 30 min or less of daily tummy time. Zachry and Kitzmann

note that these findings are concerning because Dudek-Shriber and Zelazny (2007) found that 80 min or more of daily tummy time was associated with normative gross-motor development. Considering the AAP tummy time recommendation in the "Back to Sleep, Tummy to Play" pamphlets (2008, 2017a), most of our participants (and those in Zachry and Kitzmann) were providing tummy time consistent with the AAP recommendation of "2 to 3 times a day for a short period of time (3-5 minutes), *increasing the amount of time as the baby shows he enjoys the activity*" (i.e., most participants reported at least 6 to 15 minutes, in total, daily). However, the AAP pamphlet lacks specificity regarding the ideal or the "goal" of the amount of tummy time caregivers should provide each day. Additional research is necessary to determine the optimal amount of daily tummy time needed to yield developmental gains. More recently, in discussing the importance of tummy time, the AAP (2016) commented in their policy statement that, "there are no data to make specific recommendations as to how often and how long it should be undertaken" (p. 7). Once more specific guidelines for the amount of tummy time are determined, refinement of the AAP tummy-time recommendations is warranted. As they are currently written, the AAP (2017a) recommendations may be insufficient to produce developmental gains.

Parents' worries about conducting tummy time. More than half of our parents reported being worried about conducting tummy time. The data on parents' worries are extremely informative for several reasons. First, they provide additional evidence of the need for effective tummy-time interventions given infant intolerance of the position. Such intolerance was substantial enough that it caused 20 out of our 79 parents (25.32%) worry about conducting tummy time. Second, these data tell us that some parents perceive a

substantial lack of safety associated with conducting tummy time, whether it be a fear that their baby would suffocate (7 out of 79 parents), or a fear of SIDS (4 out of 79 parents). Albeit relatively few parents had these concerns, these results are in line with other research that found that parents believed that putting their infants on their tummies at *any time*—not just for sleep—may be associated with a risk of SIDS (e.g., Koren et al., 2010). Such potential confusion regarding the risk of SIDS associated with the prone position while awake suggests that educational interventions make additional efforts to ensure that the safety associated with placing infants on their tummies, *while awake* and observed, is made very clear. Third, given that a sample of parents (3 out of 79 parents)—albeit a small sample—reported that they worried because they did not have enough time to conduct tummy time, interventions for educating caregivers about tummy time should describe ways that parents can incorporate tummy time into their daily routines. Finally, as a couple of parents reported that they worried about tummy time because their infants had acid reflux that was exacerbated in the prone position, educational interventions may want to consider discussing modifications parents can make for infants with reflux (e.g., timing of tummy time in relation to last feed).

General study limitations. One of the primary study limitations is that our sample was predominantly female. A small sample of fathers did participate in our study. As other family members (e.g., grandparents) are involved in the care of an infant, it would be important to assess the effectiveness of educational tools on enhancing the safe-sleep and tummy-time knowledge of these caregivers. Additionally, about one-third of our sample had a graduate degree, which may not be representative of the general population. Furthermore, although a relatively large sample of parents and expectant

parents who were African-American participated in our study, other minorities were largely underrepresented. It may be particularly important for researchers to assess the knowledge of American Indian/Alaska Native parents and expectant parents, as most recent data from the CDC (2015) determined that SUID rates among American Indian/Alaska Native infants are the highest compared to all other races. Despite the disparity in the incidence of SUID among American Indian/Alaskan Native infants, the literature is devoid of studies that have assessed safe-sleep knowledge and provided safe-sleep education to these parents.

As noted in the systematic review by Salm Ward and Balfour (2015) on safe-sleep interventions from 1990 to 2015, some of the common limitations in study interventions reported in the literature include (a) measurement of study outcomes using self-report data, (b) use of non-validated questionnaires, and (c) lack of measurement of changes in behavior. Experiment 1 is associated with these limitations as well. First, with respect to parents' practices of safe sleep, it is plausible that there may be a discrepancy between our participants' self-reported practices of safe sleep and their actual behavior. Specifically, participants may have underreported their unsafe sleep practices (e.g., positioning infants on their tummies for sleep or bedsharing) in favor of potentially more socially desirable responses.

There is evidence in the literature to suggest that participants in our study may have underreported unsafe sleep practices. Reports of bedsharing in our study were extremely low compared to recent estimates from a nationally-representative sample (e.g., Smith et al., 2016). Specifically, in the Study of Attitudes and Factors Effecting Infant Care Practices (SAFE), Smith and colleagues found that 20.7% of parents reported

bedsharing for at least part of the night. Additionally, Batra et al. (2016) conducted video recordings to assess infants' sleep environments throughout the night among a sample of parents who were largely White, highly educated, and from relatively high-SES backgrounds. Through single-night recordings, Batra et al. found that 28% of the 1-month old infants, 23% of the 3-month old infants, and 16% of the 6-month old infants shared a sleep surface with at least one other person. Additionally, 91% of the 1-month old infants who were moved during the night ended up on an unsafe sleep surface (e.g., parents' bed, sofa, swing) for the second sleep location. These data suggest that even among parents who are highly educated, from high-SES backgrounds, and who are aware that they are being recorded, bedsharing occurred in a relatively large percentage of the sample.

In contrast, in our sample, 1.68% of participants reported that their infant slept or would sleep in a bed for naps, and 3.31% reported a bed for nighttime sleep. Although the differences in the reports of bedsharing between our study and that of Smith et al. (2016) and Batra et al. (2016) may be due to differences in our sample and measures, it is possible that bedsharing and other unsafe sleep practices were underreported in our study because of a perceived social stigma of reporting any unsafe practices. Salm Ward and Balfour (2015) note that there are strong messages against unsafe-sleep practices, and as such, caregivers may underreport these practices. Additionally, Woods, Ahlers-Schmidt, Wipperman, and Williams (2015) found that parents reports of bedsharing were significantly higher in a community-based setting (36% of respondents) compared to primary-care settings (5% of respondents), and noted that parents may be more inclined to provide socially desirable responses in clinic-based settings.

In light of the aforementioned research, there are a couple of reasons that our study participants may have provided socially desirable responses with respect to bedsharing and other unsafe-sleep practices. First, we advertised that our study was about positioning for sleep and play, so participants may have been more inclined to report what they believed to be the "right" responses regarding how they positioned and placed their infants for sleep. Second, in our advertisements, we noted that the study was affiliated with the University of Maryland, School of Medicine, which may have influenced participants to underreport unsafe sleep practices, as there may be greater perceived social stigma of reporting unsafe practices to healthcare professionals.

One of the primary limitations of our study is that we did not measure behavior change, beyond change in responses from pre- to post-test. Our primary aim was to determine if the video we created specifically for this study was an effective tool to educate caregivers on safe sleep and tummy time. We developed the video with the hope that it would increase knowledge about safe sleep, which in turn, would change caregiver behavior. However, the efficacy of our video would have been greatly enhanced if we were able to demonstrate that, compared to before watching the video, that after watching the video, participants' intended practices (e.g., report of position and place they intend to use) or actual behavior (e.g., experimenter-observed position and location parent used for sleep) changed in favor of safer sleep practices. Future research should determine if tools to educate caregivers on safe sleep and tummy time change *intended* behavior, and should then follow-up with caregivers over time to determine if the educational tool had an impact on actual behavior. What a caregiver says they will do may be incongruous with their actual behavior (lack of correspondence between verbal and non-verbal

behavior, Israel, 1978), so it is important for researchers to determine if educational interventions have an impact on caregivers' practices, which is often the goal of such interventions. As our study and others have found, there may be barriers to implementing safe sleep and tummy time (e.g., infant intolerance of sleeping on back or intolerance of tummy time), so educational interventions may have an impact on knowledge but may not ultimately change behavior.

To summarize, our previously reported findings with respect to participants' tummy time-knowledge and practices, we found in Experiment 1 that: (a) infant intolerance of tummy time was a common caregiver barrier to implementing tummy time, (b) many parents reported that they were *worried* about conducting tummy time because of infant intolerance of the position, (c) only about 1/3 of participants identified things that a parent could do to help an infant enjoy tummy time. In addition to providing caregiver education about tummy time as we did in Experiment 1, these results further support the need for research on interventions to help infants' enjoy tummy time.

Chapter 4: Experiment 2

Experiment 2 Aims and Hypotheses

Although studies—our Experiment 1 included—have identified a clear need for effective interventions to improve infant behavior (e.g., decrease crying) during tummy time, there is limited research on such interventions. Additionally, the AAP has recommended that caregivers interact with infants and provide toys to help them enjoy tummy time, but these interventions have yet to be empirically evaluated in isolation or in combination. The studies by Kadey and Roane (2009) and Ortega and Fienup (2015) comprise the only two studies reported in the literature on interventions for tummy time, and offer promising—albeit preliminary—evidence that commonly recommended interventions for tummy time (e.g., preferred stimuli, adult interaction) can be effective in reducing crying and fussing during tummy time. Additionally, these interventions increased infants' head elevation during tummy time, which is important for gross-motor development. However, these studies are limited in the number of infants who participated (i.e., only one infant in each study) and the overall scope of the interventions the researchers evaluated. Consequently, we conducted Experiment 2 to (a) attempt to address common parental concerns about infant intolerance of tummy time, as reported in Experiment 1 and elsewhere in the literature, and (b) extend the current research on tummy time by evaluating multiple tummy-time interventions with several infant participants. The hypotheses for Experiment 2 were as follows:

Hypothesis 1. Does experimenter provision of toys and interaction—in isolation and in combination—produce decreases in infants' *negative vocalizations*? *It was expected that the provision of toys and interaction would be associated with a reduction in infant*

negative vocalizations relative to baseline sessions wherein the experimenter did not provide such toys and interaction. Specifically, it was expected that both toys and adult interaction would produce the greatest reduction in negative vocalizations, and toys alone would produce the least reduction compared to baseline.

Hypothesis 2. Does experimenter provision of toys and interaction—in isolation and in combination—produce increases in infants' *head elevation*? *It was expected the provision of toys and interaction would be associated with an increase in head elevation relative to baseline sessions wherein the experimenter did not provide such toys and interaction. Specifically, it was expected that both toys and adult interaction would produce the greatest increase in head elevation, and toys alone would produce the least increase in head elevation.*

Method

Participants, recruitment, setting and materials. Seven infants and their mothers participated in the experiment. Four mothers were first-time mothers, two mothers had one other child, and one mother had two other children. We recruited infants age 6 weeks to 4 months[31] from local childcare centers, local parent groups on social media, daycare centers, local mothers of preschoolers (MOPS) groups, pediatric clinics, children's clothing consignment sales, infant car seat safety checks. We offered parents a $50 gift card to Babies R' Us® for their participation with their infant. Additionally, to

[31] We sought to recruit only infants under 4 months of age to reduce the potential challenge that the milestone of rolling could cause during the experimental sessions. However, one participant, Marie, was already rolling at 3 months and was unavailable to participate until after she reached 4 months of age.

program for generality, we created a video of each infant's most successful tummy-time sessions and offered the video to parents as a keepsake.

The seven participants included three girls and four boys who ranged in age between approximately 2 to 4 months of age at the beginning the experiment. Table 27 lists the ages of each participant at the start and end of the experiment.

Table 27

Participants' Ages at Start and End of Experiment

Participant	Age of Infant at Start of Experiment	Age of Infant at End of Experiment
Marie	4 months, 11 days	6 months, 1 day
Therese	1 month, 23 days	2 months, 27 days
Sean	2 months, 14 days	2 months, 30 days
Amanda	1 month, 20 days	2 months, 20 days
Jean	3 months, 20 days	4 months, 23 days
Edward	3 months, 11 days	4 months, 19 days
Charles	3 months, 8 days	5 months, 8 days

Six of the seven infants completed the experiment in their own home. One of the participants (Jean) was the primary experimenter's child and completed the study in a room in a laboratory at a local university. Within those settings, we conducted all sessions in a space with the least noise and distractions. The materials for this study included a timer, a foam mat measuring approximately 82 cm x 82 cm, a plain white towel for each participant, a Flip™ video camera with a tripod, a tri-fold white poster board, and two identical Genius Babies® Busy Bee 3-in-One Baby Toy Play Mats measuring 40 cm x 40 cm. The mat was marketed for tummy time and included many

features that others have recommended (e.g., Bronson, 1995; Zachry, 2013), which may stimulate infants and improve tummy time (e.g., reduce crying), such as different textures of fabric, items to reach for and grab, contrasting colors, and a mirror. The mat was versatile in that it could be laid flat on the floor or folded into a triangle and placed in front of the infant. For all sessions, we placed the foam mat on the floor, with the individual participants' white towel on top. For other sessions, we also placed one tummy-time mat flat on top of the towel and folded the second tummy-time mat into its triangular shape, with the mat's mirror and other stimulating objects approximately 20 to 25 cm in front of the infant's head.

Response measurement and interobserver agreement. The primary dependent measures included the percentage of 10-s momentary-time sampling (MTS) intervals with negative vocalizations and head elevation. *Negative vocalizations* included any whining, crying, coughing, or "fussing." *Elevated head* involved instances in which the participant's head was not in contact with the mat, his/her hands or forearms, or the mother's chest.

Secondary dependent measures included the "level" of the infants' head elevation. We derived these levels from gross-motor milestones in the *Best Beginnings Developmental Screen* (Hussey-Gardner, 2016), which included (a) head face down, (b) head down- face cleared to side, (c) head up- forward facing, (d) head up- face turned to side, (e) chest up, (f) forearm support, and (e) hand support. Operational definitions for these behaviors and others are included in Appendix P, along with the session protocol, and sample images of each condition. As the different levels of head elevation require varying degrees of physical effort and developmental maturity, we scored the specific

type of head elevation to help capture any changes in level of head elevation that may be associated with the experimental conditions. Observers scored all behaviors using 10-s momentary-time sampling (MTS), in which every 10 s, observers would stop the video and record which level of head elevation was occurring. Hanley, Cammilleri, Tiger, and Ingvarsson (2007) identified that MTS intervals up to 120 s may be acceptable to use for duration events (i.e., estimate the occurrence of an event with minimal absolute error), whereas Becraft, Borrero, Davis, and Mendres-Smith (2016) found that intervals of up to 90 s were acceptable. That being said, we selected a 10-s MTS interval because other research suggests that absolute error is lowest when the MTS-interval is about the same or smaller than the duration of the behavior (Wirth, Slaven, & Taylor, 2014). Given that the different levels of the infant's head elevation can change very rapidly (i.e., the duration of a single level may be just a second or two), we decided that a relatively small interval would be best to maximize sensitivity.

We also selected 10-s intervals over relatively larger ones in light of the total session duration. As sessions could be terminated as early as 2 min (or 1 min for most of Edward's sessions), larger MTS intervals (e.g., 90-s intervals) would minimize the number of opportunities we had to capture the changes in the levels of head elevation. Hanley et al. (2007), found that when the total number of observations per session was less than 9 (which corresponded to the 120-s MTS), there were marked changes in the absolute error. Thus, in using a 10-s MTS interval, we could gather 12 to 18 observations in a 2 to 3-min session, respectively. This is on par with the number of observations in Hanley's 60- and 90-s intervals, which had minimal error when compared to the 5-s MTS.

We evaluated interobserver agreement (IOA) by having two trained observers independently, but not simultaneously, collect data an average of 65.62% (range across participants = 50% to 100%) of the sessions via video recordings. We used the interval-by-interval method, wherein for each 10-s MTS interval, we scored whether the two observers agreed that each behavior did or did not occur. We scored agreements with a "1" and disagreements with a "0." We used a modified method of calculating IOA for head elevation. Specifically, as only one level of head elevation could occur at a given time, we evaluated agreement for the level of head elevation by scoring a "1" if both observers scored the exact same level, and assigned "0.5" (i.e., "half-credit") if the observers agreed +1/-1 one level. For instance, if both observers scored "chest up," we assigned "1," but if one observer scored "chest up," and the other observer scored "forearm support" (i.e., the difference of only one level), we assigned "0.5." However, if one observer scored "chest up," and the other observer scored "hand support," (i.e., the difference of two levels), we assigned a "0." *Overall head elevation* was a less conservative measure of head elevation (i.e., whether head was on or off of the mat). That is, if one observer scored "head face down" and the other observer scored "head cleared to side" we assigned a "1" as both observers agreed that the infant's head was down. We divided the number of agreements by the total number of intervals, and then multiplied by 100%. We then determined the mean across all sessions to yield a mean IOA value for each behavior.

Appendix Q provides the agreement scores for each participant. Mean IOA was 94.77% for negative vocalizations, 97.26% for overall head elevation, 92.81% for the level of head elevation, and 96.39% for verbal attention and 93.53% for physical

attention in the experimenter interaction, experimenter interaction + toy, and parent-interaction conditions. For treatment integrity purposes, we also scored the delivery of attention (i.e., the lack thereof) for the baseline and toy only conditions. Mean IOA was 100% for both verbal and physical attention for the baseline and toy conditions.

Procedure. The UMBC Institutional Review Board approved this experiment. We obtained informed consent from all parents prior to the start of the study. We also asked parents to complete a screening checklist, to determine if their infant (a) had any diagnoses (e.g., acid reflux disease, major perinatal complications, hearing or visual impairments), (b) was born prior to 32 weeks gestation, (c) was receiving physical therapy, or (d) had colic and if there were times of the day that their infant was generally "fussy."

All participants were born full term with no major perinatal complications. One infant (Edward) was diagnosed by his pediatrician with torticollis (tightening of muscles in his neck), and his pediatrician and occupational therapist encouraged his parents to conduct tummy time. Edward was not receiving services from a physical therapist at the time of the study. As a result of his torticollis, Edward had begun to develop a flattening of his head (i.e., positional plagiocephaly), and his occupational therapist encouraged his parents to seek an evaluation to determine if a helmet would be needed to correct the shape of his head.

After completing the screening form, we then asked parents to complete the questionnaires and watch the video associated with Experiment 1, to gather information regarding each participant's extra-experimental history with tummy time and as a clinical service to provide safe-sleep and tummy-time education.

Treatment evaluation. We conducted all treatment sessions in an identified space with the least noise and distractions within the participant's home (or laboratory office for Jean). We placed each infant in the center of the mat for all sessions. Each infant participated in the experiment at least one day a week. On those days, we conducted at least one session, each 5-min in duration. We terminated sessions early, however, if the infant engaged in two *consecutive* min of negative vocalizations[32]. Each session was followed by at least a 5-min break, wherein the primary experimenter or parent held and provided high-quality attention to the infant. Neither the primary experimenter nor the parent placed the infant on his/her tummy during breaks.

To reduce crying that may be associated with variables other than exposure to tummy time, the primary experimenter ensured that the infant (a) was not to be fed within a half hour of the start of the session, if fed on a schedule and (b) was alert and not engaging in any negative vocalizations for at least 1 min prior to the start of session. The infant was considered alert if he or she had wide, open eyes, and did not flail his or her limbs, frown, or yawn, within the 1 min prior to the start of session[33]. We included the 1-min criteria of the alert state and no negative vocalizations to help ensure that the infant was not drowsy at the beginning of the session and to help ensure that any negative vocalizations that may occur were the result of the manipulation of the variables within the session. Additionally, if the infant was engaging in negative vocalizations prior to the start of the session, the infant's mother then checked the infant's diaper and changed the

[32] For Edward, beginning with session 9, a 1-min termination criterion was used, which is described later.
[33] Adapted from the "quiet alert" state of consciousness, described as "eyes open wide, face is bright; body is quiet" (AAP, 2009).

diaper if it was wet or dirty. If these negative vocalizations occurred during a break in-between sessions and the diaper needed to be changed, the infant's mother changed the diaper at that time. If the infant was engaging in negative vocalizations during the session, the mother checked the infant's diaper immediately after the termination of the session and changed the diaper, if needed.

The intervention conditions were evaluated using a single-case experimental design to demonstrate the effects of the independent variable on responding. Specifically, a multi-element design with a reversal condition (i.e., to the baseline condition) was used. A multi-element design involves rapid alternation of more than one condition (e.g., alternation of two or more independent variables; Kazdin, 2010). At least three baseline sessions were first conducted. Thereafter, the three experimenter-led intervention conditions were randomly alternated, followed by the parent-led condition (described below). A reversal to the baseline condition concluded the experiment for all participants except Sean.

Baseline. All baseline sessions began with the primary experimenter placing the infant in the prone position on the foam mat covered by the infant's white towel, facing a white backdrop (i.e., a tri-fold white poster board). No other stimuli were directly in front of the infant. At the start of the session, the primary experimenter positioned the infant's head face down. Additionally, the primary experimenter placed both of the infants' hands and forearms in contact with the floor under the infant's upper torso (i.e., slightly under and to the right of the infant's sternum). The primary experimenter and observers did not provide any items, attention, or any other stimulation during baseline sessions. The

primary experimenter and parent remained out of view, but the primary experimenter remained within arm's reach of the participant if any unsafe circumstances were to arise.

After at least three baseline sessions, we reviewed the data to determine whether to proceed to the intervention conditions. If the infant engaged in negative vocalizations, on average, for less than 25% of the session duration and/or elevated his/her head, on average, for 75% or greater of session duration, he/she was excluded from the experiment. Specifically, we used the following four-celled decision matrix to determine if infants would be included or excluded from further participation:

Table 28

Decision Matrix for Study Inclusion and Exclusion

Baseline Findings	Progress to Experiment (Y/N)
A. Head elevated for ≥ 75% of session; Negative vocalizations for ≥ 25% of session	Yes
B. Head elevated for ≥ 75% of session; Negative vocalizations for ≤ 24% of session	No
C. Head elevated for ≤ 74% of session; Negative vocalizations for ≤ 24% of session	Yes
D. Head elevated for ≤ 74% of session; Negative vocalizations for ≥ 25% of session	Yes

These exclusion criteria were necessary because there would not be much room to show improvement in the intervention conditions should an infant engage in low levels of negative vocalizations and high levels of head elevation in the absence of the intervention components. That being said, all participants' behavior during baseline fell under category "D" above. That is, these participants' behavior demonstrated the greatest need

for intervention, as head elevation was relatively low and negative vocalizations were relatively high during baseline.

Intervention I: Experimenter-led sessions. In Intervention I, we provided all interaction on the floor with the infant during the (a) interaction and (b) toy + interaction conditions, described below. The primary experimenter participated in the interaction sessions for all participants, except Jean, who was the primary experimenter's daughter. For these sessions, one of two other experimenters provided attention to Jean. The primary experimenter did not participate in the experimenter-led sessions with her infant because familiarity with one's parent compared to a novel adult may have affected the results. Additionally, as it is estimated that greater than one-third of infants are cared for by non-familial adults during the day[34], we wanted to assess the effectiveness of the initial interventions with someone who was a non-familial adult.

Toy. The toy condition was identical to baseline, with the exception that the primary experimenter provided stimulating objects to the infant. Specifically, the primary experimenter placed one tummy-time mat on top of the infant's towel, and laid the infant on top of this mat, facing the second tummy-time mat. The primary experimenter secured this second mat into its triangular shape and placed it about 20 to 25 cm in front of the infant's head. The primary experimenter did not provide any interaction during these sessions.

Interaction. During these sessions, the experimenter placed the baby on the plain mat covered by the participant's white towel and did not provide any toys or other

[34] The US Census Bureau (2013) data indicated that the percentage of children under 1 year being cared for by non-relatives were as follows: 15.9% in daycare center, 4.0% by non-relative in child's home, 9.6% in family daycare, 6.7% in other non-relative care.

stimulating objects during these sessions. The experimenter laid on the floor perpendicularly in front of the infant, placing her head approximately 30 cm from the infant's head, and provided continuous verbal attention. Such attention consisted of responding to infant actions (e.g., "Wow! You are lifting your head so high!") or providing soothing or encouraging statements (e.g., "It's okay [baby's name]. You can do it!"). If the infant engaged in negative vocalizations, the experimenter also provided physical attention that consisted of patting or stroking the baby on his/her back or limbs.

Toy + Interaction. The toy plus adult interaction condition was conducted as described above for both the toy and adult interaction conditions. That is, both interventions occurred concurrently.

Intervention II: Parent-led sessions. We initially proposed to only conduct the three aforementioned experimenter-led interventions. For all participants, the effects of Intervention I on negative vocalizations and/or head elevation were limited. Thus, to help reduce negative vocalizations and increase head elevation, Intervention II—each led by the infant's mother—was added to the study.

Parent Interaction + Toy + Incline Position. In this condition, the mother provided continuous verbal attention to the infant and showed him/her a toy. Additionally, the mother was seated on a couch (or bench, for Jean's mother), lying on an incline position at approximately a 30° angle, with her infant on her chest (i.e., chest to chest). To ultimately help increase the potential success of this intervention, all three components (interaction from mother, toy, and incline position) were evaluated at once. Prior to the start of this condition, the primary experimenter told the mother to interact with the baby continuously, in a manner that she normally would. The primary

experimenter also asked the mother to identify an object that her infant seemed to interact with the most. The mother then held this object up in front of the infant's face, either to the right or left of her shoulder, while interacting with the infant.

Data Analysis. We determined the effectiveness of the interventions using visual inspection. Specifically, we compared the percentage of the session in which the infant engaged in negative vocalizations and had his or her head elevated in a single condition to all other conditions. We placed particular emphasis on the level, trend, and variability of the intervention conditions compared to those in the baseline condition.

Social-Validity Questionnaire. Following the termination of the study, we evaluated the mother's satisfaction with their infant's change in negative vocalizations and head elevation during the intervention conditions. We sent each mother (except Jean's mother, who was the primary experimenter), a link to a SurveyMonkey® questionnaire and offered a $10 gift card to a local department store for completing the questionnaire. Appendix R presents the Social-Validity Questionnaire. As we decided to evaluate social validity well after some participants had already completed their participation[35] and it might have been difficult for some mothers to remember their infant's behavior, we also provided the mother with a bar graph to aid her in completing the questionnaire. This bar graph included two panels; one panel depicted the mean percentage of session that her infant engaged in negative vocalizations and other depicted the mean percentage of session with elevated head. Within each panel, we provided the percentage of session with either negative vocalizations or elevated head in (a) the initial

[35] Most of the participants had completed their participation approximately nine months before we sent out the survey; two participants completed the study in the prior two months.

baseline, (b) the experimenter-led sessions (i.e., one bar included the average of *all* Intervention I sessions), and (c) the parent-led sessions. The mothers rated how much they agreed that the experimenter-led sessions and parent-led sessions with helped their baby lift his/her head and cry less, on a 5-point scale, ranging from strongly agree to strongly disagree. We also evaluated (a) the mothers' likelihood of conducting tummy time before and after the study, (b) if she continued to conduct tummy time, the type of tummy time she implemented with her baby the most (e.g., on her chest, on floor with toys), (c) the reason she chose that tummy-time activity, and (d) following the completion of the study, how much her infant cried and lifted his/her head during tummy time (ranging from "not at all" to "all the time"). There was also space at the end of the survey for the mothers to provide additional feedback about the study or her infant's behavior during tummy time.

Results

Treatment evaluation.

Treatment integrity. We scored the delivery of verbal and physical attention across all conditions in the experiment to measure the extent to which the experimenter and mothers delivered attention as planned. Per our protocol, during the experimenter interaction and experimenter interaction + toy condition, the experimenter was to provide continuous verbal attention, but also provided physical attention only to soothe the infant or to gain his/her attention. On average, the experimenter delivered verbal and physical attention to the infants during 99.14% and 62.52% of intervals, respectively. With respect to parent interaction, we simply asked mothers to interact with their infants continuously,

in a manner that they normally would. On average, the mothers delivered verbal and physical attention during 91.16% and 11.28% of their sessions, respectively.

Effectiveness of the experimenter-led session in decreasing negative vocalizations (Hypothesis 1). Figure 2 depicts the percentage of session with negative vocalizations (top panel) and elevated head (bottom panel), for all participants, in the initial baseline and all intervention conditions. Table 29 presents the percentage of session with negative vocalizations for all conditions of the experiment, for all participants, as well as the overall means. On average, each experimenter-led condition was associated with a reduction in negative vocalizations, compared to the initial baseline (baseline $M = 80.64\%$). Recall that in Hypothesis 1, we expected that that the provision of toys and interaction would be associated with a reduction in negative vocalizations relative to baseline sessions wherein the experimenter did not provide such toys and interaction. Specifically, we expected that both toys and adult interaction would produce the greatest reduction in negative vocalizations, and toys alone would produce the least reduction compared to baseline. On average, the toy + interaction condition *did* produce the greatest reduction in negative vocalizations, and the toy condition produced the least reduction in negative vocalizations, compared to the initial baseline. Thus, Hypothesis 1 was supported.

That being said, there was not a large difference in the percentage of session with negative vocalizations between each of the experimenter-led conditions (i.e., toy + interaction condition $M = 62.18\%$, interaction condition $M = 69.25\%$, and toy condition $M = 72.73\%$). Furthermore, we conducted paired-samples t-tests to determine if each intervention was significant from the initial baseline. Compared to the initial baseline, the

only intervention that was associated with a statistically significant reduction in negative vocalizations was the parent-interaction condition, $t(6) = 4.36$, $p = .005$ (toy = $t[6] = 0.99$, $p = .363$; experimenter interaction = $t[6] = 1.16$, $p = .291$; experimenter interaction + toy = $t[6] = 1.80$, $p = .123$). We saw the same effect with head elevation, in that compared to the initial baseline, the only intervention that was associated with a statistically significant increase in head elevation was the parent-led condition, $t[6] = -3.17$, $p = .019$ (toy = $t[6] = -.17$, $p = .875$; experimenter interaction = $t[6] = .23$, $p = .822$; experimenter interaction + toy = $t[6] = -1.66$, $p = .148$).

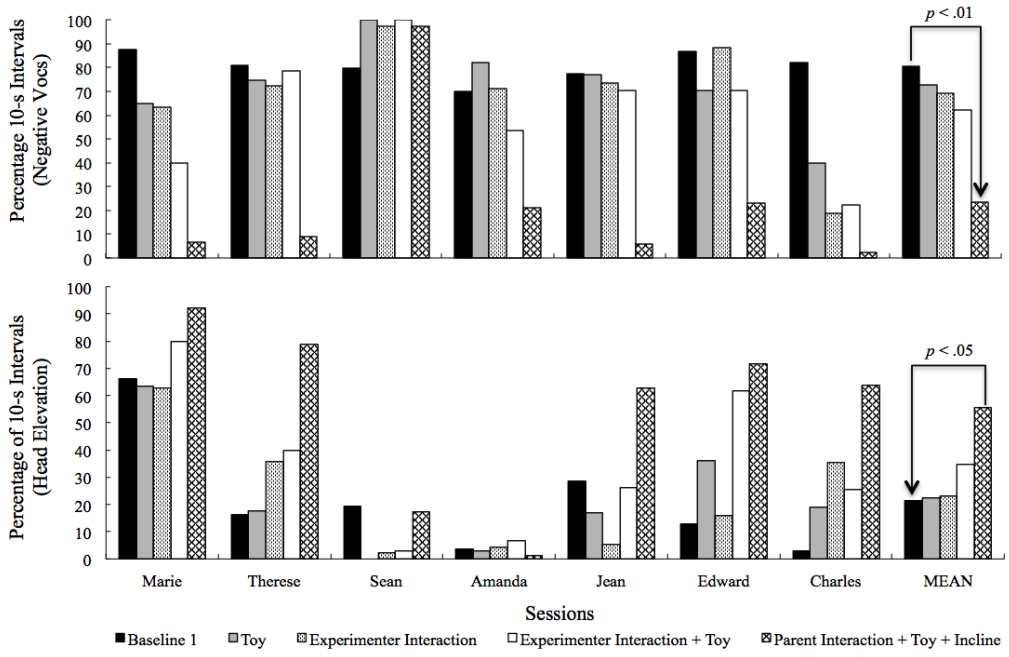


Figure 2. Percentage of each session with negative vocalizations (top panel) and elevated head (bottom panel). Means include the last three sessions of the first baseline phase, all three intervention sessions for each experimenter-led condition, and the last three sessions of the parent-led condition (parent interaction + toy + incline).

Table 29

Mean Negative Vocalizations across Conditions

	Mean Negative Vocalizations across Conditions					
		Experimenter-Led Intervention			Parent-Led Intervention	
Participant	Baseline 1	Toy + Interaction	Interaction	Toy	Toy + Interaction + Incline	Baseline 2
Marie	87.45%	39.78%	63.18%	64.87%	6.67%	77.22%
Therese	80.95%	78.76%	72.22%	74.56%	8.89%	97.78%
Sean	79.84%	100.00%	97.44%	100%	97.44%	N/A
Amanda	70%	53.71%	71.02%	82.22%	21.11%	86.26%
Jean	77.32%	70.24%	73.67%	77.17%	5.75%	88.33%
Edward	86.94%	70.55%	88.33%	70.29%	23.06%	88.43%
Charles	81.99%	22.22%	18.89%	40%	2.30%	8.89%
Group Mean	80.64%	62.18%	69.25%	72.73%	23.60%	74.49%

Effectiveness of the experimenter-led session in increasing head elevation (Hypothesis 2). Table 30 presents the percentage of session with elevated head for all conditions of the experiment, for all participants, as well as the overall means. Recall that in Hypothesis 2, we expected that the provision of toys and interaction would be associated with an increase in head elevation relative to baseline sessions wherein the experimenter did not provide such toys and interaction. Specifically, we expected that both toys and adult interaction would produce the greatest increase in head elevation, and toys alone would produce the least increase in head elevation. On average, each experimenter-led condition did produce an increase in head elevation, compared to the initial baseline (baseline $M = 21.40\%$). Thus, we accepted Hypothesis 2. However, as with negative vocalizations, there was not a very large difference in the percentage of

session with elevated head in the experimenter-led conditions, compared to the initial baseline. Between conditions, the toy + interaction condition was much more effective in increasing head elevation (*M* = 34.70%) compared to the interaction (*M* = 23.13%) and the toy conditions (*M* = 22.32%). Although the difference between the overall averages for head elevation in the interaction and toy condition is small, as we expected, the toy + interaction condition *did* produce the greatest increase in head elevation, and toys alone produced the least increase in head elevation (but the difference between the toy and the interaction condition was very small).

Table 30

Mean Head Elevation across Conditions

Mean Head Elevation across Conditions						
		Experimenter-Led Intervention			**Parent-Led Intervention**	
Participant	Baseline 1	Toy + Interaction	Interaction	Toy	Toy + Interaction + Incline	Baseline 2
Marie	66.28%	80.02%	62.74%	63.56%	92.15%	30.72%
Therese	16.24%	40.03%	35.84%	17.78%	78.89%	39.08%
Sean	19.44%	2.78%	2.38%	0%	17.42%	N/A
Amanda	3.45%	6.64%	4.31%	2.78%	1.11%	4.17%
Jean	28.67%	26.24%	5.26%	16.99%	62.95%	9.71%
Edward	12.92%	61.64%	15.83%	36.11%	71.67%	65.67%
Charles	2.78%	25.56%	35.56%	19.02%	63.95%	64.44%
Group Mean	21.40%	34.70%	23.13%	22.32%	55.45%	35.63%

Individual participants' results. Figure 3 depicts the treatment evaluation results for Marie. The baseline condition produced elevated levels of negative vocalizations (top panel of Figure 3) and low levels of head elevation (bottom panel of Figure 3). Of the

three experimenter-led interventions, the experimenter-led toy + interaction condition was associated with the greatest reduction in negative vocalizations and increase in head elevation. Although effective in reducing negative vocalizations and increasing head elevation, we wanted to evaluate if another intervention would be associated with a greater impact on infant behavior, so we then introduced the parent-led sessions. The parent-led condition produced a 92.37% decrease in negative vocalizations relative to the initial baseline, and a 90.76% reduction relative to the replication of the baseline condition. Additionally, nearly all sessions were terminated early due to 2-consecutive min of negative vocalizations, except the parent-led sessions. With respect to head elevation, the parent-led condition produced a 39.03% increase in head elevation relative to the initial baseline, and a 199.97% increase relative to the replication of the baseline condition.

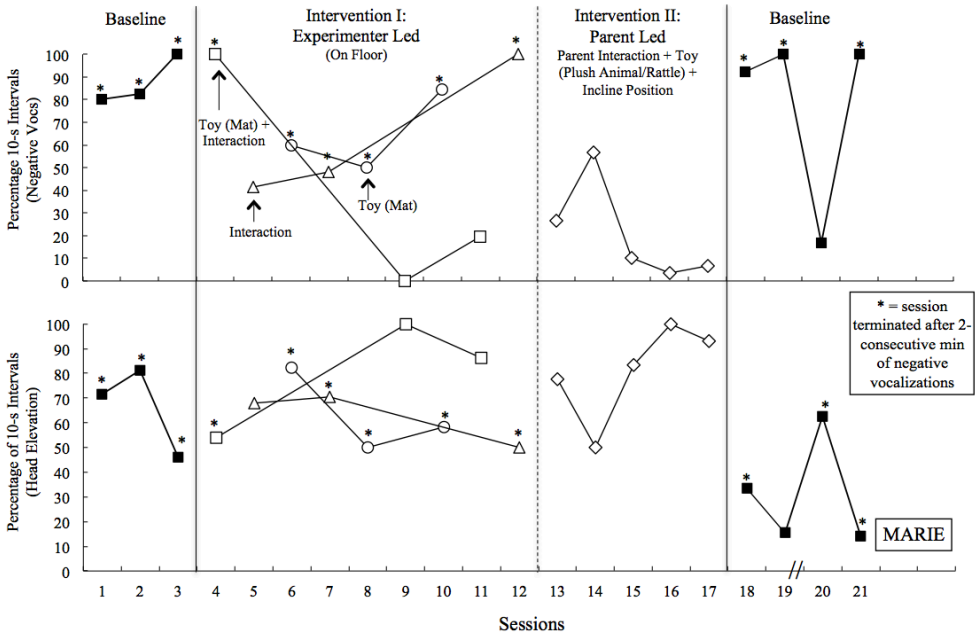


Figure 3. Percentage of session with negative vocalizations (top panel) and elevated head (bottom panel) for Marie. X-axis scale break denotes a 14-day break in sessions.

Figure 4 depicts the specific levels of Marie's head elevation across the experimental conditions, grouped by category. For this figure and the subsequent head elevation figures that follow, we grouped head elevation into categories to more readily demonstrate any qualitative changes in head elevation levels. Specifically, the two variations of head down (i.e., head face down and down to side) we grouped into "Category 1," the two variations of head up (i.e., head up to side and forward facing) we grouped into "Category 2," and the three variations of head elevation in which the infant was supporting an additional part of his/her body (i.e., chest up, forearm support, and hand support) we grouped into "Category 3." Notably, in the parent-led condition, Marie allocated most of her head elevation to Category 3 levels (i.e., chest up, forearm support, and hand support), relative to the initial baseline and experimenter-led conditions wherein Marie engaged mainly in Category 1 levels (i.e., head face down and to side) and Category 2 levels (i.e., head up to side and forward facing).

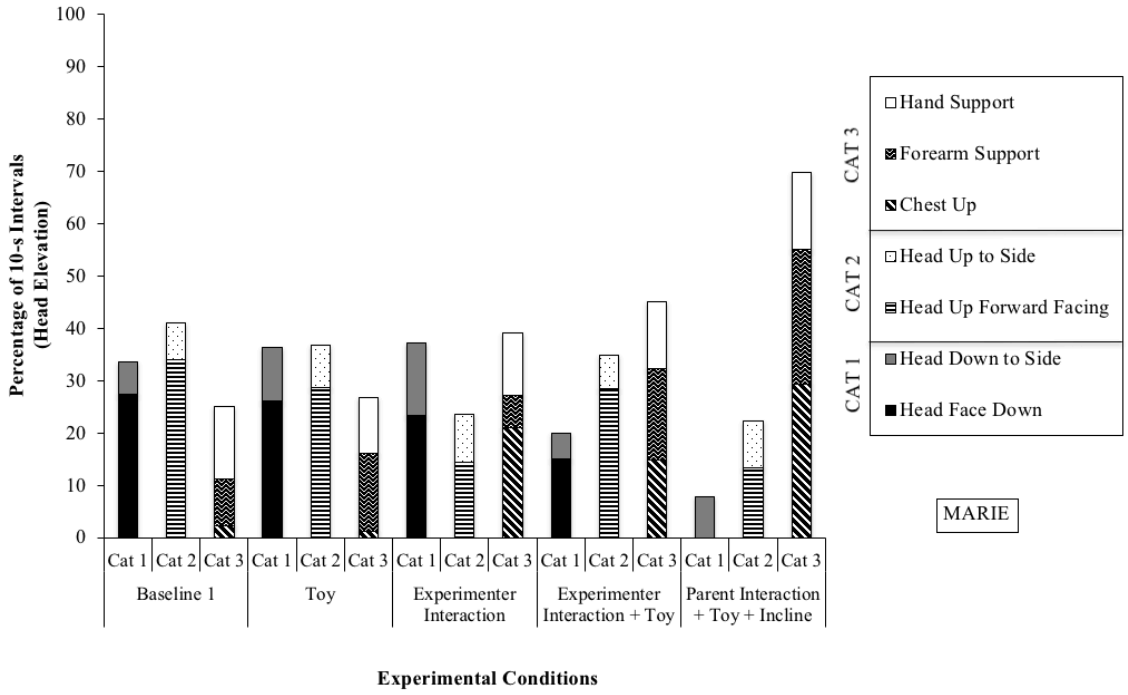


Figure 4. Percentage of 10-s intervals with different levels of head elevation, across experimental conditions, for Marie. *Note:* "Cat" = "Category."

Figure 5 depicts the treatment evaluation results for Therese. The baseline condition produced elevated levels of negative vocalizations and low levels of head elevation. The experimenter-led sessions were associated with a slight reduction in negative vocalizations and increase in head elevation. Notably, the experimenter-led interaction + toy condition was associated with the greatest increase in head elevation. As with Marie, the parent-led sessions were associated with a further increase in head elevation and reduction in negative vocalizations. Specifically, the parent-led condition produced an 89.02% decrease in negative vocalizations relative to the initial baseline, and a 90.91% reduction relative to the replication of the baseline condition. Additionally, most of the parent-led sessions we did not need to terminate early due to 2-consecutive min of negative vocalizations, in contrast to our early termination of nearly all other

sessions. With respect to head elevation, the parent-led condition produced a 385.78% increase in head elevation relative to the initial baseline, and a 101.87% increase relative to the replication of the baseline condition.

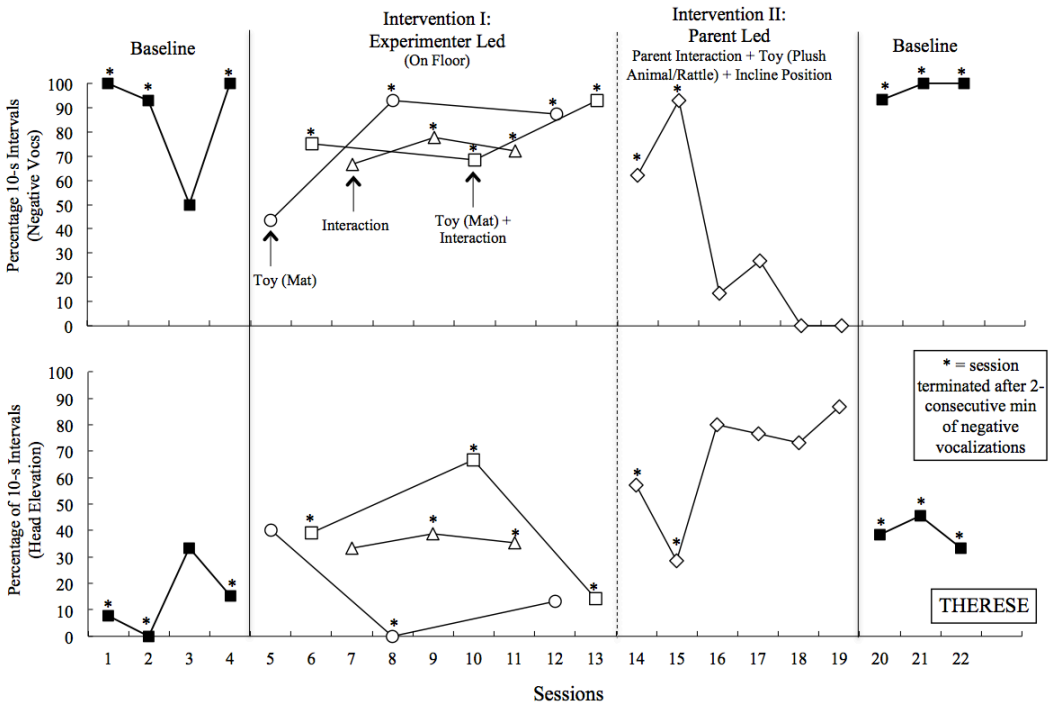


Figure 5. Percentage of session with negative vocalizations (top panel) and elevated head (bottom panel) for Therese.

Figure 6 depicts the specific levels of Therese's head elevation across the experimental conditions. Notably, the experimenter-led conditions were associated with an increase in Category 2 levels, relative to the initial baseline, wherein Therese primarily engaged in Category 1 levels. Additionally, the parent-led condition was associated with the greatest increase in Category 3 levels, relative to the initial baseline.

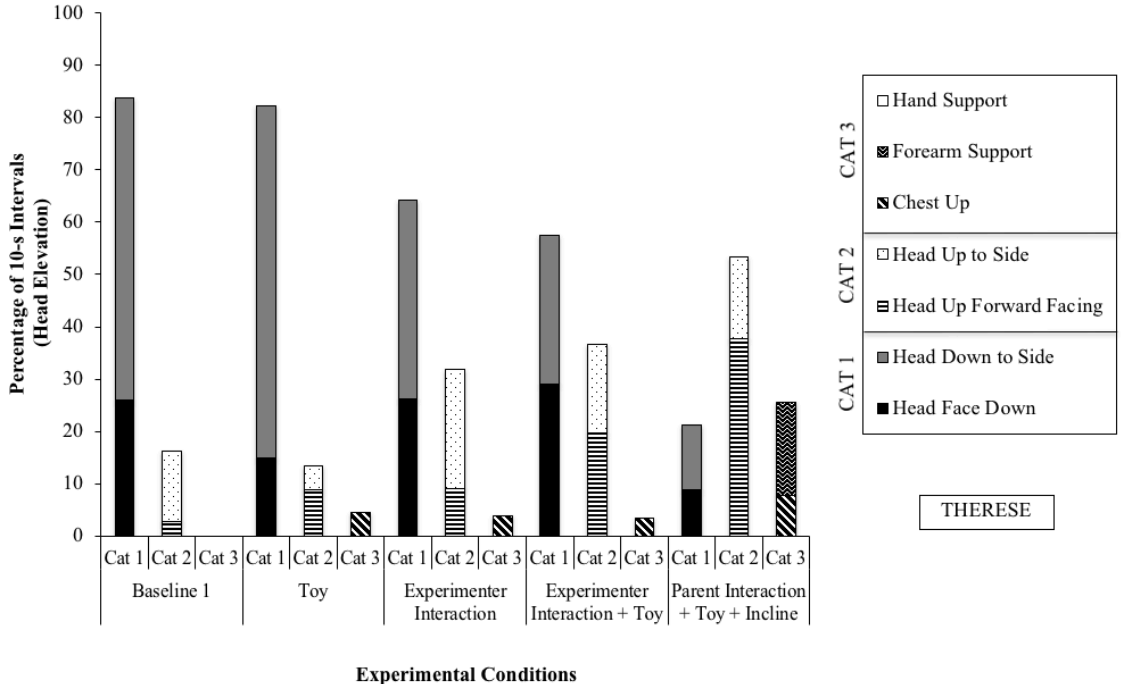


Figure 6. Percentage of 10-s intervals with different levels of head elevation, across experimental conditions, for Therese. *Note:* "Cat" = "Category."

Figure 7 depicts the treatment evaluation results for Sean. The baseline condition produced elevated levels of negative vocalizations and low levels of head elevation. The experimenter-led sessions were associated with consistently high levels of negative vocalizations and near-zero levels of elevated head. After introducing the parent-led condition, the high levels of negative vocalizations and low levels of elevated head remained, although there was a very slight increase in head elevation in the final few session of the parent-led condition, relative to the experimenter-led condition. We needed to terminate nearly all sessions early due to 2-consecutive min of negative vocalizations.

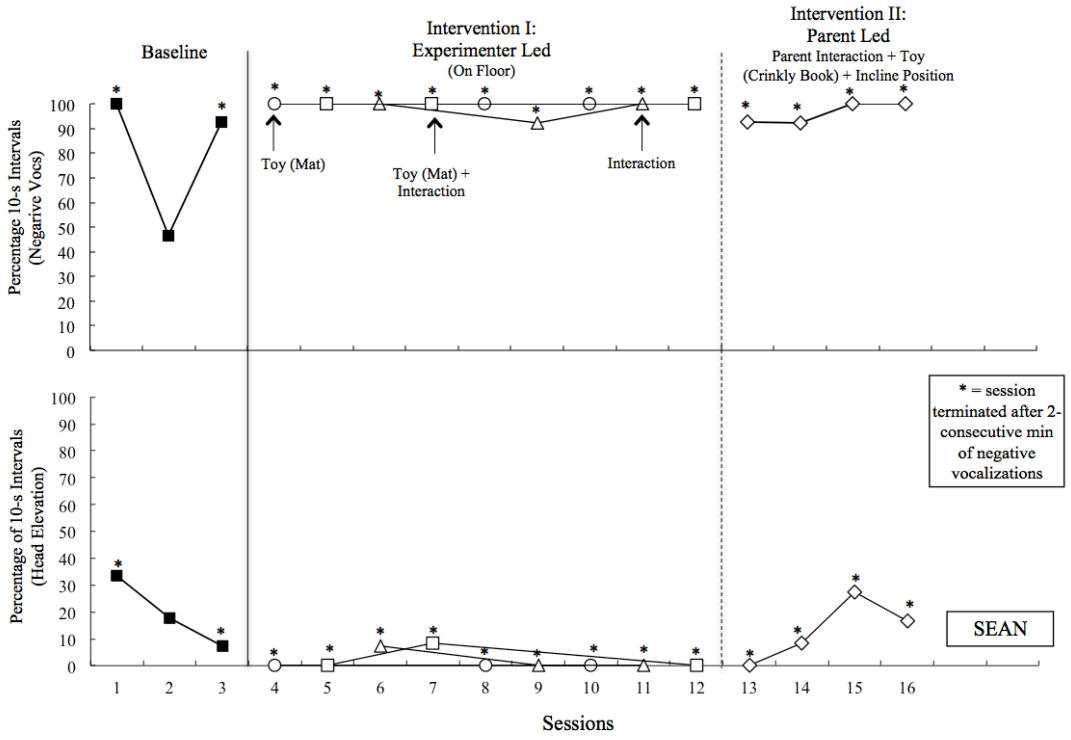


Figure 7. Percentage of session with negative vocalizations (top panel) and elevated head (bottom panel) for Sean.

Figure 8 depicts the specific levels of Sean's head elevation across the experimental conditions. Levels of head elevation were generally consistent across the experimental conditions, with head down to side (Category 1) occurring during the largest percentage of intervals throughout the experiment. Levels of head elevation from Category 2 and 3 rarely occurred.

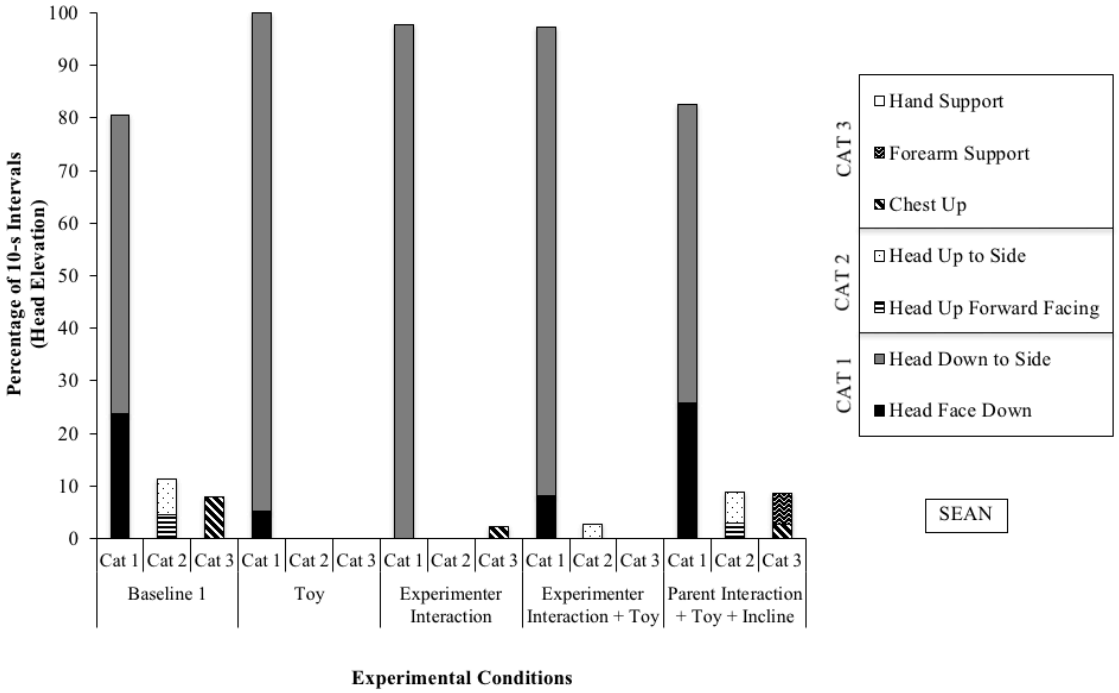


Figure 8. Percentage of 10-s intervals with different levels of head elevation, across experimental conditions, for Sean. *Note:* "Cat" = "Category.

Figure 9 depicts the treatment evaluation results for Amanda. As with the other participants, the baseline condition produced elevated levels of negative vocalizations and low levels of head elevation. Collectively, the experimenter-led sessions were not associated with a reduction in negative vocalizations or increase in head elevation. However, although the parent-led condition was not associated with an increase in head elevation, these sessions were associated with a large reduction in negative vocalizations. Specifically, the parent-led condition produced a 69.84% reduction in negative vocalizations relative to the initial baseline, and a 75.53% reduction relative to the replication of the baseline condition. Additionally, most sessions were terminated early due to 2-consecutive min of negative vocalizations, except the parent-led sessions.

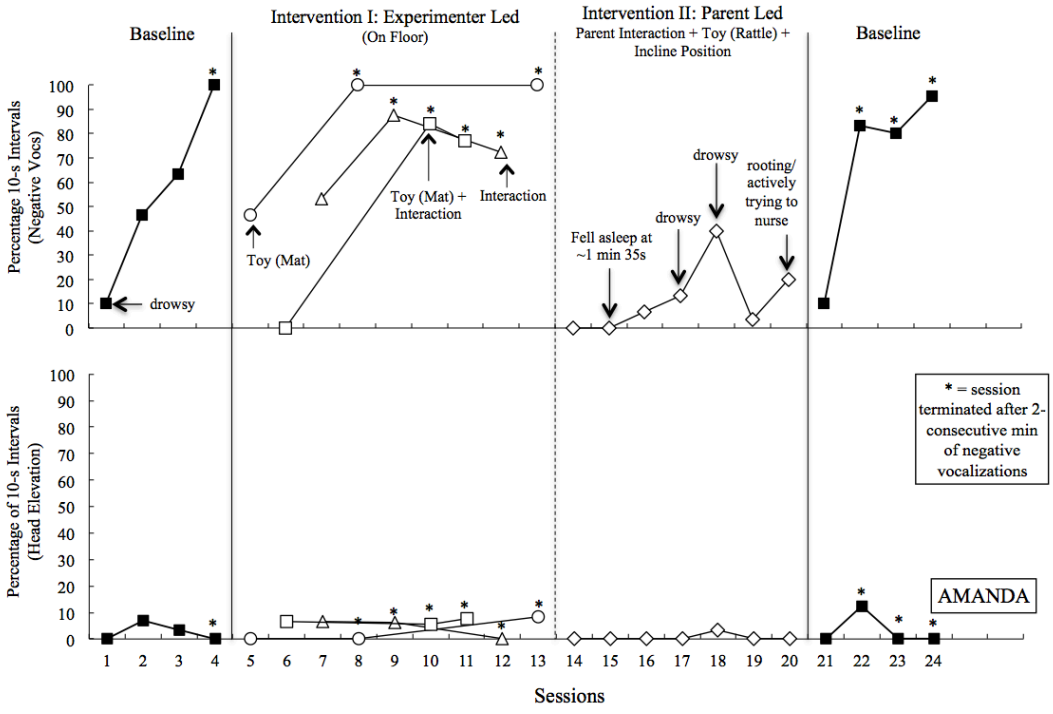


Figure 9. Percentage of session with negative vocalizations (top panel) and elevated head (bottom panel) for Amanda.

Figure 10 depicts the specific levels of Amanda's head elevation across the experimental conditions. Amanda's level of head elevation was consistent across all experimental conditions, with nearly all intervals consisting of Category 1 levels (i.e., head face down and head down to side).

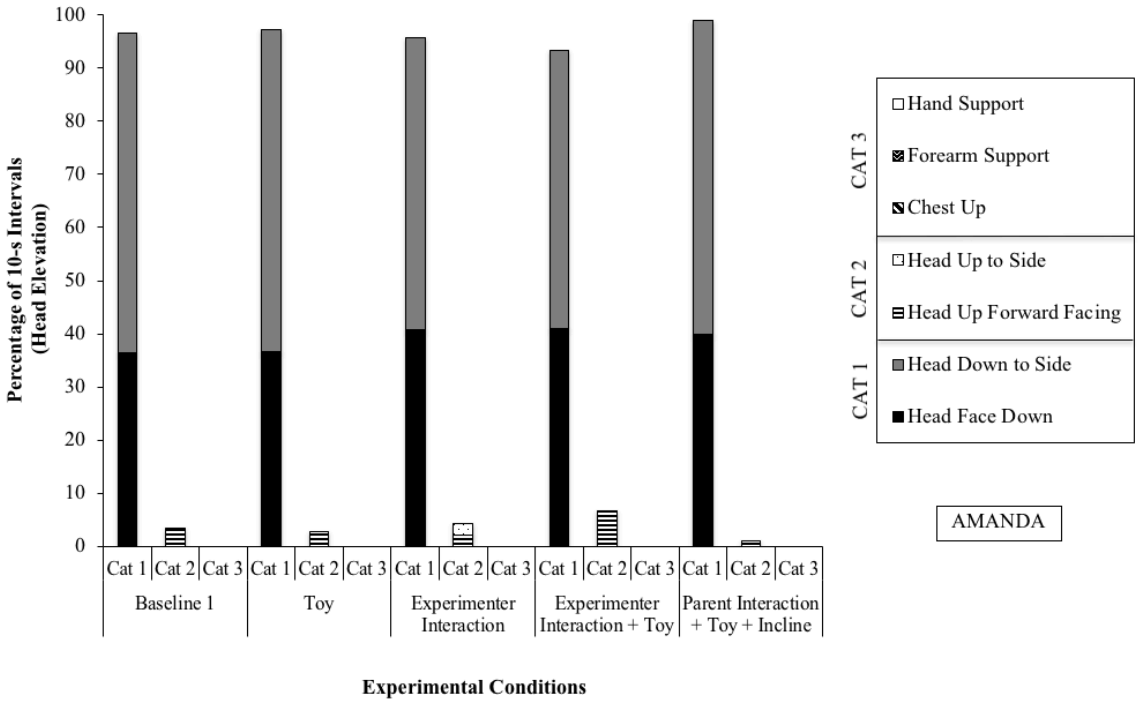


Figure 10. Percentage of 10-s intervals with different levels of head elevation, across experimental conditions, for Amanda. *Note:* "Cat" = "Category.

Figure 11 depicts the treatment evaluation results for Jean. As with the other participants, the baseline condition produced elevated levels of negative vocalizations and low levels of head elevation. Collectively, the experimenter-led sessions were not associated with a reduction in negative vocalizations or increase in head elevation. However, upon initiating the parent-led condition, negative vocalizations dropped to low levels and head elevation increased to relatively high levels. Specifically, the parent-led condition produced a 92.56% reduction in negative vocalizations relative to the initial baseline, and a 93.49% reduction relative to the replication of the baseline condition. Additionally, the parent-led condition produced a 119.57% increase in head elevation relative to the initial baseline, and an 548.30% increase in head elevation relative to the

replication of the baseline condition. Notably, all sessions were terminated early due to 2-consecutive min of negative vocalizations, except the parent-led sessions.

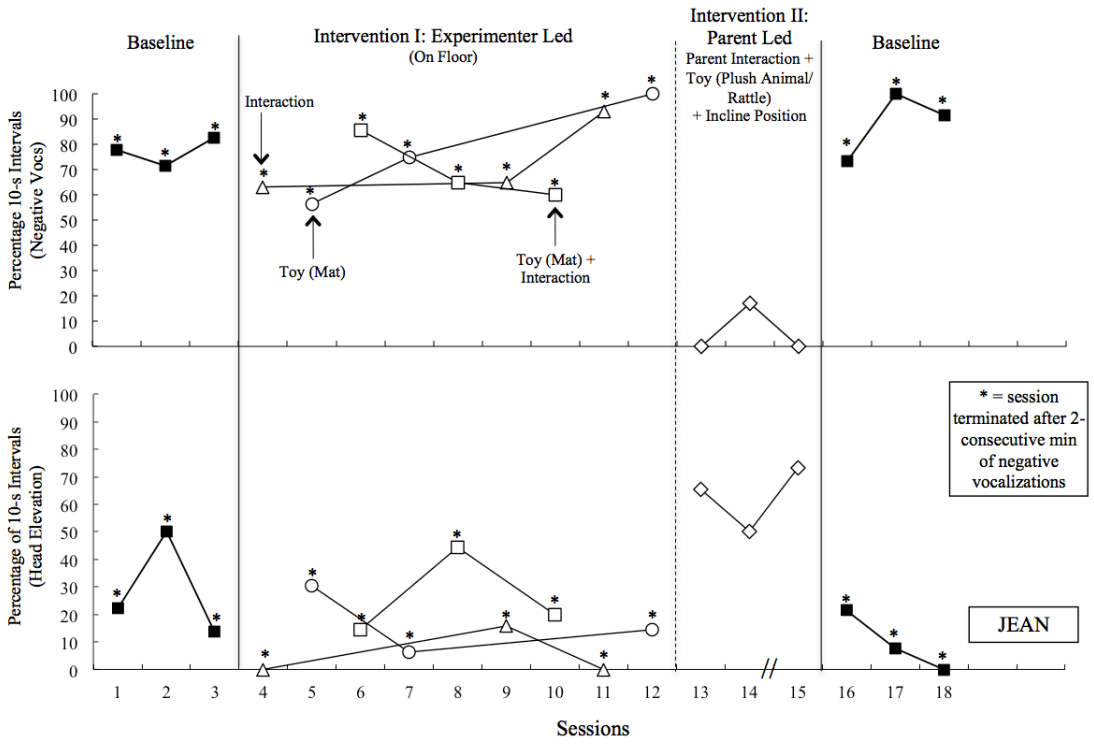


Figure 11. Percentage of session with negative vocalizations (top panel) and elevated head (bottom panel) for Jean. X-axis break denotes a 14-day break in sessions.

Figure 12 depicts the specific levels of Jean's head elevation across the experimental conditions. Jean engaged in primarily Category 1 levels during the initial baseline and the experimenter-led conditions. However, she allocated her responding to Category 2 and 3 levels in a much larger percentage of intervals in the parent-led condition, relative to baseline and the experimenter-led condition.

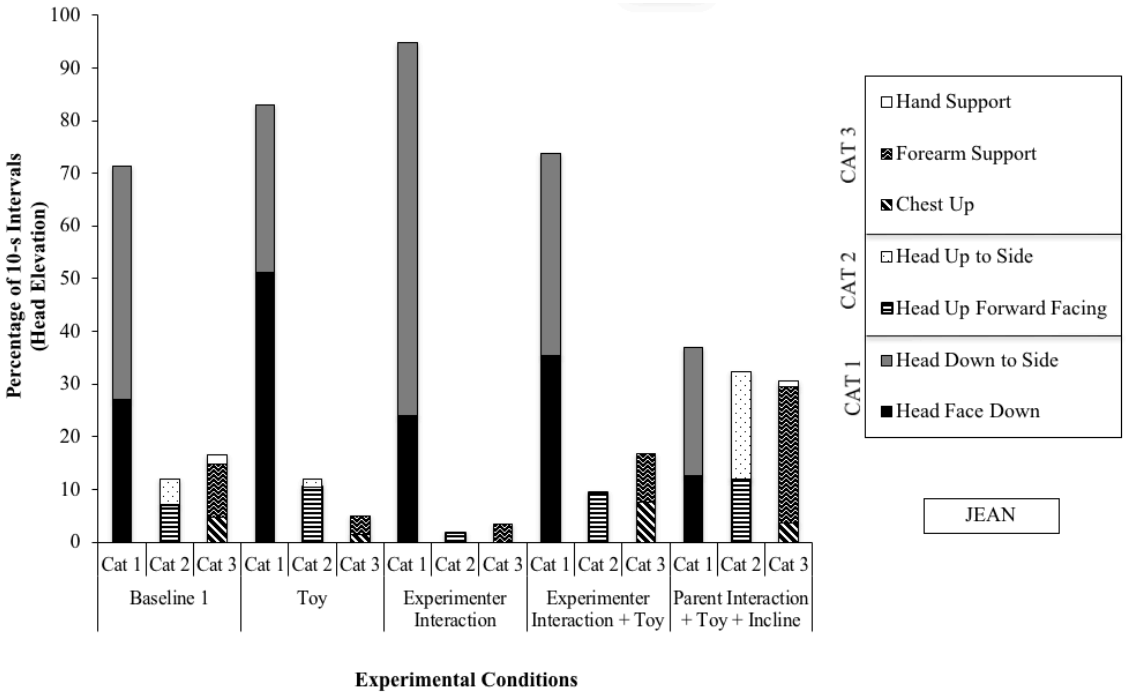


Figure 12. Percentage of 10-s intervals with different levels of head elevation, across experimental conditions, for Jean. *Note:* "Cat" = "Category.

Figure 13 depicts the treatment evaluation results for Edward. As with the other participants, the baseline condition produced elevated levels of negative vocalizations and low levels of head elevation. Collectively, the experimenter-led sessions were not associated with a substantial reduction in negative vocalizations, but the experimenter-led interaction + toy condition was associated with a large increase in head elevation. The toy condition was associated with an increase in head elevation as well, but this increase was relatively small compared to the experimenter-led interaction + toy condition. It should be noted that, beginning with session 9, the primary experimenter terminated sessions after 1 min of negative vocalizations. This modification was made because the mother

reported how distressed she was hearing her baby cry, and she would often walk out of the room during sessions because it was "too anxiety provoking" to hear his crying. Similarly, Ortega and Fienup (2015) reported that they had to terminate baseline sessions because the infant's negative vocalizations were "too stressful for the mother" (p. 67). In addition to terminating the sessions after 1 min of negative vocalizations, we had Edward's mother identify a distracting activity she could do during the sessions (i.e., checking and responding to emails). To help increase tolerance to infant cries, professionals recommend that parents engage in a distracting activity (e.g., Goulet et al., 2009) and this recommendation is supported by research (i.e., Glodowski & Thompson, 2017). Once these modifications were made, Edward's mother reported that she was better able to tolerate his cries.

Like most of the other participants, the parent-led condition was associated with a large reduction in negative vocalizations and an increase in head elevation, relative to the initial baseline. Specifically, the parent-led condition produced a 73.48% reduction in negative vocalizations relative to the initial baseline, and a 73.92% reduction relative to the replication of the baseline condition. Additionally, the parent-led condition produced a 454.72% increase in head elevation relative to the initial baseline, and a 9.14% increase in head elevation relative to the replication of the baseline condition. Notably, head elevation was much higher in second baseline relative to the first, suggesting that exposure to the experimental conditions may have been associated with gross-motor development, and such gross-motor development may have facilitated head elevation in the absence of toys or interaction. This may be particularly true for Edward, given that he

had torticollis and his mother reported that the tightening in his neck improved over the course of the experiment (see social validity results to follow).

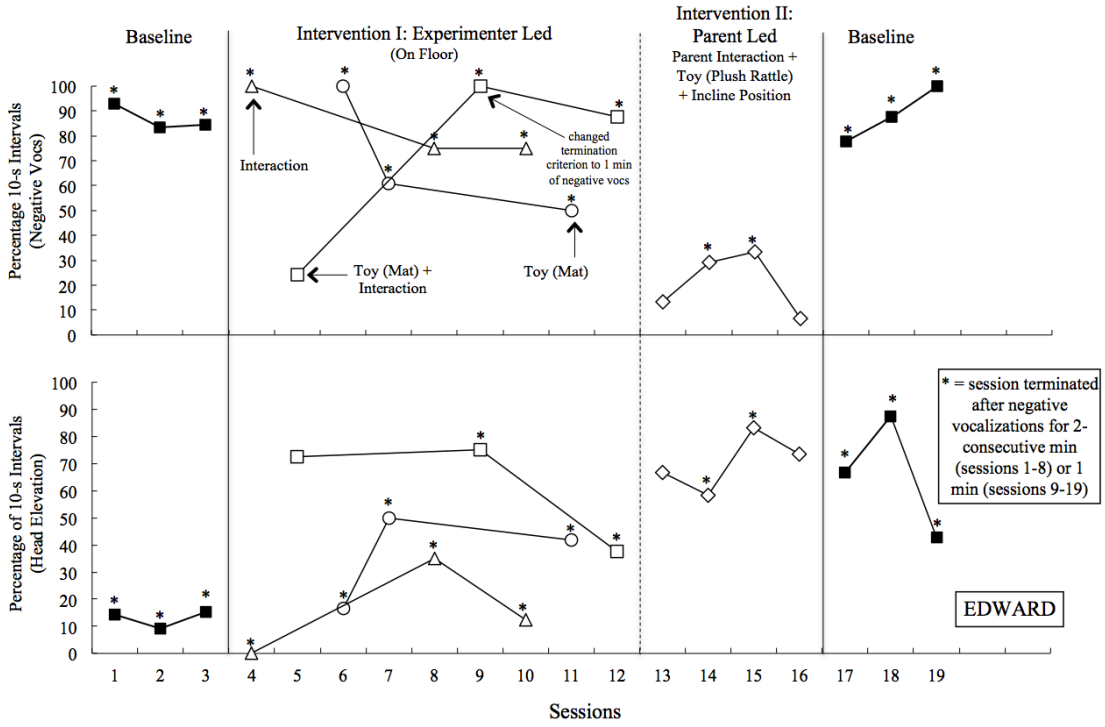


Figure 13. Percentage of session with negative vocalizations (top panel) and elevated head (bottom panel) for Edward.

Figure 14 depicts the specific levels of Edward's head elevation across the experimental conditions. Edward primarily placed his head face down in the initial baseline, toy, and experimenter-interaction conditions. This behavior required the primary experimenter to often intervene to clear Edward's head to the side that was not tight due to his torticollis. However, the parent-led condition was associated with a reduction in head face down and a large increase in Category 3 levels; specifically, chest up and forearm support.

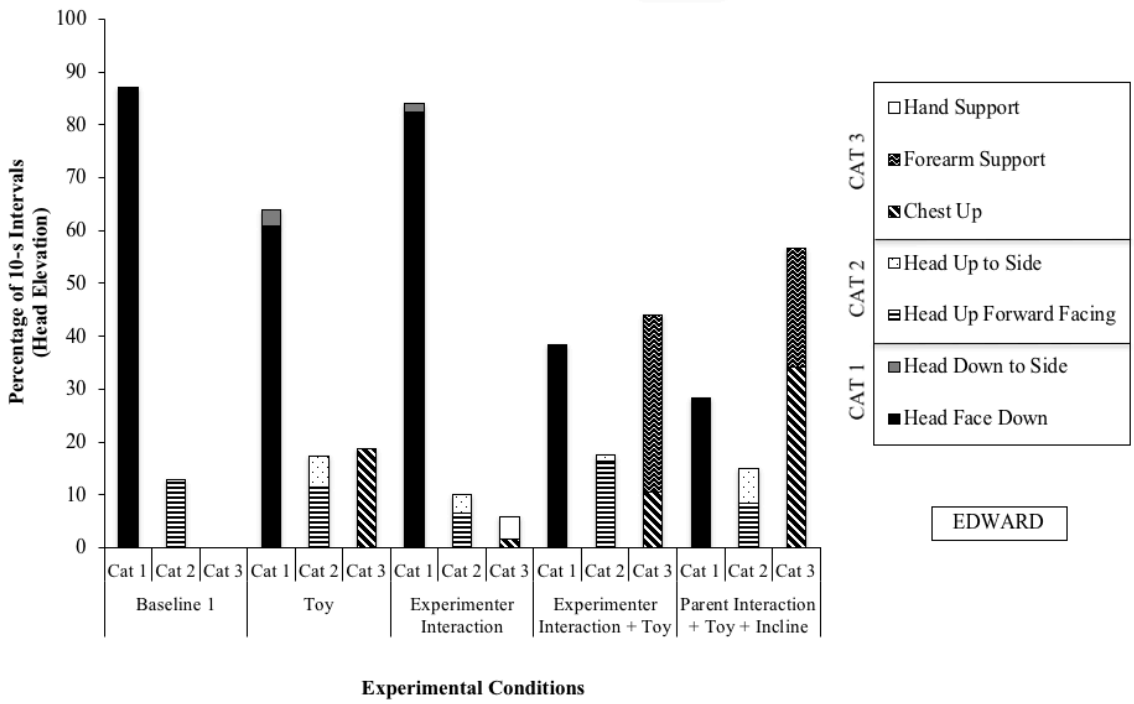


Figure 14. Percentage of 10-s intervals with different levels of head elevation, across experimental conditions, for Edward. *Note:* "Cat" = "Category.

Figure 15 depicts the treatment evaluation results for Charles. As with the other participants, the baseline condition produced elevated levels of negative vocalizations and low levels of head elevation. Although variable, collectively, the experimenter-led sessions were associated with a large reduction in negative vocalizations and a moderate increase in head elevation. As with most of the other participants, the parent-led condition was associated with a much larger reduction in negative vocalizations and increase in head elevation, relative to the initial baseline. Specifically, the parent-led condition produced a 97.19% reduction in negative vocalizations relative to the initial baseline, and a 74.13% reduction relative to the replication of the baseline condition. Additionally, the parent-led condition produced a 2,200.36% increase in head elevation

relative to the initial baseline, but was not associated with an increase relative to the replication of the baseline condition.

The lack of a reversal for negative vocalizations *and* head elevation may be explained by the 13-day break in sessions after the first session in the return to baseline. That is, developmental maturity—such as improved gross-motor skills while in the prone position—may have occurred during this time period, making tummy time easier for Charles during those final sessions. In turn, the less physical effort required during tummy time may have been reflected in the relatively high level of head elevation compared to baseline, and in the relatively low level of negative vocalizations.

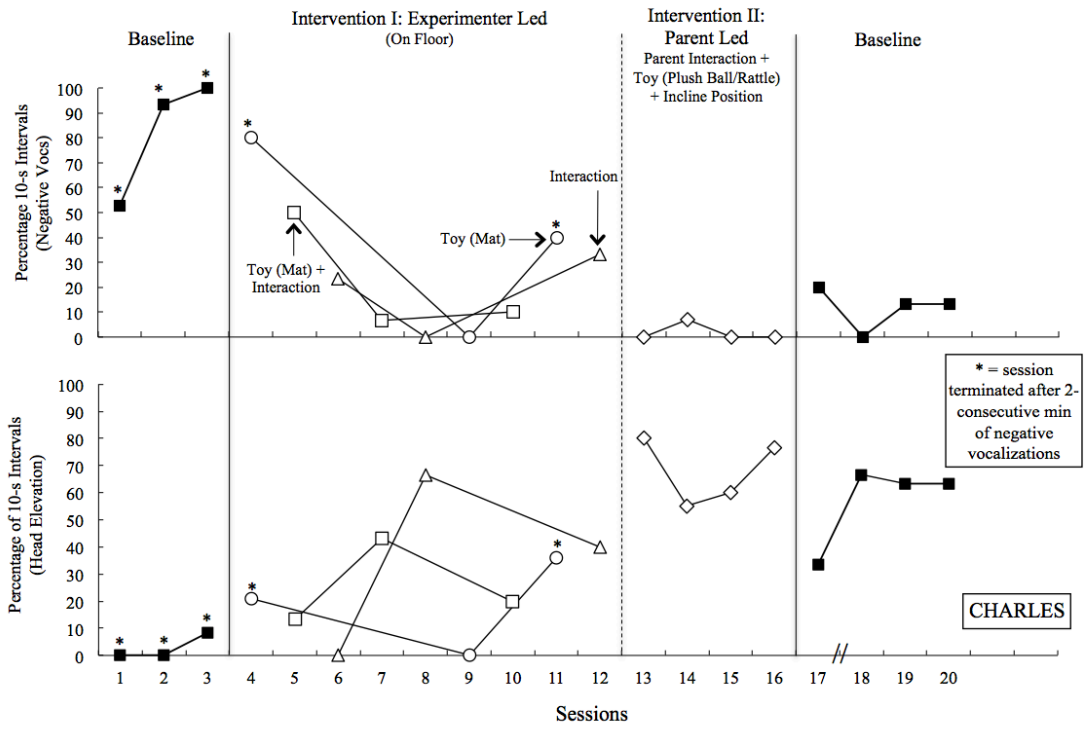


Figure 15. Percentage of session with negative vocalizations (top panel) and elevated head (bottom panel) for Charles. X-axis break denotes a 13-day break in sessions.

Figure 16 depicts the specific levels of Charles' head elevation across the experimental conditions. In baseline, Charles primarily had his head down to the side and head face down (Category 1), but as the experiment progressed to the experimenter-led sessions, there was a decrease in these Category 1 levels and a slight increase in Category 2 and 3 levels. The experimenter-interaction condition in particular was associated with an increase in Category 3 levels (i.e., mainly chest up). However, the parent-interaction condition was associated with the greatest percentage of intervals with Category 3 head elevation. Notably, Charles propped himself up on his forearms during most of the intervals in the parent-led condition.

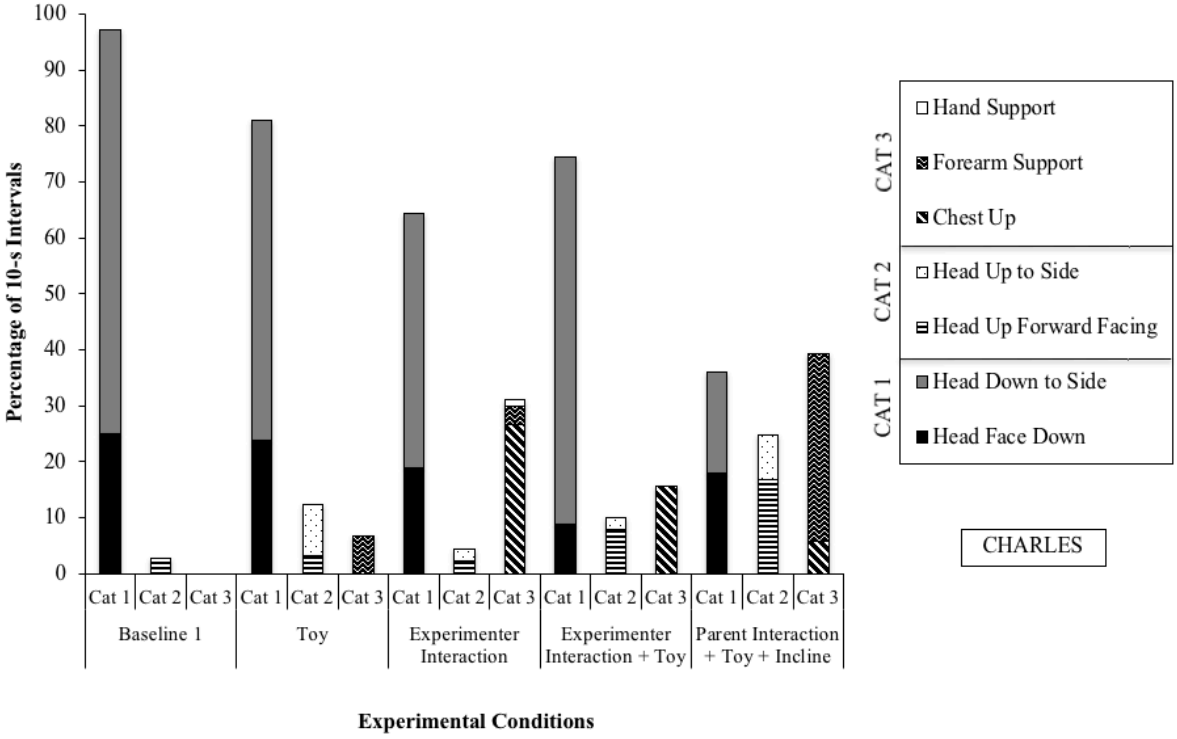


Figure 16. Percentage of 10-s intervals with different levels of head elevation, across experimental conditions, for Charles. *Note:* "Cat" = "Category.

Social-Validity Questionnaire Results. Five of the seven mothers who participated in the study completed the Social-Validity Questionnaire. As previously noted, Jean's mother did not complete the survey because she was the primary-experimenter for the experiment. Amanda's mother could not be reached and as such, she did not complete the survey. Table 31 presents the remaining five mothers' ratings regarding whether, prior to the start of the study, they experienced emotional difficulty or reluctance to conduct tummy time when their infant cried, as well as whether they would pick their infants up if they cried when on their tummy. Three of the five mothers reported that they either "strongly agreed" or "agreed" that it was emotionally difficult for them when their infant cried during tummy time, prior to the start of the study. Four of the five mothers reported that they "strongly agreed" that their baby's crying made them reluctant to conduct tummy time, and three of the five mothers reported that they "strongly agreed" that if their infants cried during tummy time, they would pick them up shortly after they started crying.

Table 31

Emotional Difficulty, Reluctance, and Termination of Tummy Time

	Response	Frequency	Percentage
1.	**Prior to the start of the study, when my baby cried during tummy time, this was emotionally difficult for me.** (N = 5)		
	Strongly agree	1	20%
	Agree	2	40%
	Neutral	1	20%
	Disagree	1	20%
	Strongly disagree	0	0%
2.	**Prior to the start of the study, my baby's crying made me reluctant to conduct tummy time.** (N = 5)		
	Strongly agree	4	80%
	Agree	0	0%
	Neutral	0	0%
	Disagree	1	20%
	Strongly disagree	0	0%
3.	**Prior to the start of the study, when my baby cried during tummy time, I would pick him/her up shortly after he/she started crying (i.e., within 30 seconds of crying).** (N = 5)		
	Strongly agree	3	60%
	Agree	1	20%
	Neutral	0	0%
	Disagree	1	20%
	Strongly disagree	0	0%

Table 32 presents the mothers' satisfaction with how the sessions on the floor (i.e., the experimenter-led sessions) helped their infants cry less and lift their heads more. Two mothers reported that they "strongly agree" that they were satisfied with how they sessions helped their infants cry less and two mothers reported "neutral" to this question. Perhaps not surprisingly, the mother of the one participant for whom we saw no decrease in negative vocalizations or increase in head elevation during the experiment—Sean—reported that she "disagreed" that she was satisfied with how these sessions helped her

infant cry less. Four of the five mothers reported that they either "strongly agreed" (N = 2) or "agreed" (N = 2) that they were satisfied with how the experimenter-led sessions helped their infants lift their heads. Sean's mother reported that she "disagreed" that she was satisfied with how these sessions helped her infant lift his head.

Table 32

Mothers' Satisfaction with the Experimenter-Led Sessions

4. I was satisfied with how the sessions *on the floor* (e.g., with tummy time mat, interaction with experimenter) helped my baby *cry less*. (N = 5)		
Response	**Frequency**	**Percentage**
Strongly agree	2	40%
Agree	0	0%
Neutral	2	40%
Disagree	1	20%
Strongly disagree	0	0%
5. I was satisfied with how the sessions *on the floor* (e.g., with tummy time mat, interaction with experimenter) helped my baby *lift his/her head*. (N = 5)		
Strongly agree	2	40%
Agree	2	40%
Neutral	0	0%
Disagree	1	20%
Strongly disagree	0	0%

Table 33 presents the mothers' satisfaction with how the parent-led sessions helped their infants cry less and lift their heads more. Four of the five mothers reported that they "strongly agreed" that they were satisfied with how these sessions helped their infants cry less and lift their heads more. Sean's mother reported that she "disagreed" that she was satisfied with how these sessions both helped her infant cry less and lift his head more.

Table 33

Mothers' Satisfaction with the Parent-Led Sessions

6. I was satisfied with how the sessions *on my chest while I interacted with my baby* helped my baby *cry less*. ($N = 5$)		
Response	**Frequency**	**Percentage**
Strongly agree	4	80%
Agree	0	0%
Neutral	0	0%
Disagree	0	0%
Strongly disagree	1	20%
7. I was satisfied with how the sessions *on my chest while I interacted with my baby* helped my baby *lift his/her head*. ($N = 5$)		
Strongly agree	4	80%
Agree	0	0%
Neutral	0	0%
Disagree	0	0%
Strongly disagree	1	20%

Table 34 presents mothers' likelihood of conducting tummy time following the completion of the study and the type of tummy-time activity she used. Three of the five mothers reported that they were more likely to conduct tummy time with their infants following the completion of the study, compared to prior to the start of the study. Sean's mother reported that she "disagreed" that she was more likely to conduct tummy time following the completion of the study. Marie's mother reported "neutral" to this question.

Two of the five mothers (Marie's mother and Therese's mother) reported that the type of tummy-time activity they implemented the most following the completion of the study was putting their infants on their chest while they interacted with them. That is, these mothers continued using the parent-led intervention, without toys. Marie's mother reported using this tummy-time activity because it was the "most preferred way to conduct tummy time for baby, least crying, most effective" and Therese's mother

reported using this tummy-time activity because "it was the easiest, and most similar to what we were already doing."

Two of the five mothers (Sean's mother and Edward's mother) reported that they put their infants on tummy-time mat or with toys, while they interacted with them. Sean's mother reported doing so because he "never liked tummy time. He always found it difficult and cried despite attention or toys. I did continue to try but not consistently or frequently." Edward's mother reported doing so because "I found it to be an easier activity during the course of the day to get on the floor with him and his toys and play with him. Also, he likes to roll over from tummy to back very quickly. I found that staying on the floor with him helps me manage how much time he spends on his tummy." Charles' mother reported that she put her baby on a tummy-time mat or with toys to play by himself because "I found that he was able to explore and learn more by playing on his own. I initially sat with him and praised him on the floor but once I felt more comfortable, I allowed him to play alone He does really great with it!"

Table 34

Mothers' Implementation of Tummy Time Following Study Completion

8. Following the completion of the study, I was more likely to conduct tummy time with my baby than I was prior to the start of the study. (*N* = 5)		
Response	**Frequency**	**Percentage**
Strongly agree	3	60%
Agree	0	0%
Neutral	1	20%
Disagree	1	20%
Strongly disagree	0	0%
9. Following the completion of the study, the type of tummy-time activity that I implemented with my baby <u>the most</u> was: (*N* = 5)		
Putting baby on tummy-time mat or with toys to play by him/herself	1	20%
Putting baby on tummy-time mat or with toys while I interacted with him/her	2	40%
Putting baby on floor without toys while I interacted with him/her	0	0%
Putting baby on my chest while I interacted with him/her	2	40%
Putting baby on my chest while I showed him/her toys and interacted with him/her	0	0%
I did not conduct tummy time with my baby	0	0%
Other type of tummy-time activity used	0	0%
10. Why did you choose the activity selected in #9? (If you did not conduct tummy time with baby, please explain why you did not conduct tummy time.) (*N* = 5)		
Putting baby on tummy-time mat or with toys to play by him/herself (*N* = 1)		
"I found that he was able to explore and learn more by playing on his own. I initially sat with him and praised him on the floor but once I felt more comfortable, I allowed him to play alone. He does really great with it!"		

Putting baby on tummy-time mat or with toys while I interacted with him/her ($N = 2$)
"[Participant's real name] never liked tummy time. He always found it difficult and cried despite attention or toys. I did continue to try but not consistently or very frequently."
"I found it to be an easier activity during the course of the day to get on the floor with him and his toys and play with him. Also, he likes to roll over from tummy to back very quickly. I found that staying on the floor with him helps me manage how much time he spends on his tummy.
Putting baby on my chest while I interacted with him/her ($N = 2$)
"Most preferred way to conduct tummy time for baby, least crying, most effective"
"It was the easiest, and most similar to what we were already doing"

Table 35 presents mothers' ratings of how often their infants cried and lifted their heads during tummy time, following the completion of the study. Marie's mother, Therese's mother, and Edward's mother reported that their infants cried "some of the time" during tummy time, following the completion of the study. Sean's mother reported that he cried "all of the time" and Charles' mother reported that he cried "not at all" during tummy time following the completion of the study. With respect to elevated head, Therese's mother and Edward's mother reported that they lifted their heads "all of the time" following the completion of the study. Marie's mother, Sean's mother, and Charles' mother reported that they lifted their heads "most of the time."

Table 35

Infant Behavior During Tummy Time Following Study Completion

11. Please answer #11 and #12 if you conducted tummy time following the completion of the study: In the month following the completion of the study, when I did tummy time with my baby he/she cried: ($N = 5$)		
Response	**Frequency**	**Percentage**
Not at all	1	20%
Some of the time	3	60%
About half of the time	0	0%
Most of the time	0	0%
All of the time	1	20%
I'm not sure of can't remember	0	0%
12. In the month following the completion of the study, when I did tummy time with my baby he/she lifted his/her head: ($N = 5$)		
Not at all	0	0%
Some of the time	0	0%
About half of the time	0	0%
Most of the time	3	60%
All of the time	2	40%
I'm not sure of can't remember	0	0%

Appendix S presents mothers' full descriptive feedback about the study and tummy time with their infants. Feedback was largely positive. Charles' mother noted,

> Before my son participated in the study, I was incredibly reluctant to put him down for tummy time due to the frequency of his crying. I also felt less confident putting him down for tummy time and often felt nervous about letting him cry… I was happy to learn new skills through the study and am certain that my son's development has improved as a result of his participation.

Similarly, Edward's mother noted,

> Before the study, I was putting my baby on his tummy and when he cried, I would quickly pick him up or put him on his back. The study helped me work through

> the emotional reaction to my baby's crying and ultimately helped him tolerate his tummy better. My child has torticollis and the tummy time study truly improved his mobility. And I gained more confidence in his ability to tolerate his tummy better.

Sean's mother expressed that she felt that tummy time was "too stressful for him" and commented that the reason Sean's "neck muscles developed on time was due to baby wearing which was recently found to build the same muscles instead of tummy time."[36]

Discussion

The purpose of Experiment 2 was to evaluate the effectiveness of toys and interaction on decreasing infants' negative vocalizations and increasing head elevation during tummy time. Results of Kadey and Roane (2012) and Ortega and Fienup (2015) offer some preliminary evidence that stimulation during tummy time may be an effective intervention. For six of the seven participants (i.e., all participants except Sean), the experimenter-led interventions were associated with some reduction in negative vocalizations. Additionally, for five of the seven participants (i.e., all participants except Sean and Jean), at least one of the experimenter-led interventions was associated with an increase in head elevation.

Although the experimenter-led interventions were effective in decreasing negative vocalizations and increasing head elevation for most participants, the effectiveness of these interventions were limited. That is, on average, participants continued to engage in negative vocalizations for most of the duration of the experimenter-led sessions (*M* range

[36] "Babywearing" is the practice of carrying a baby close to you by placing him/her in a sling, wrap, or another infant carrier.

= 62.18% to 72.73%) and lifted their heads for only about one-third of the duration of these sessions (*M* range = 22.32% to 34.70%). Because of the limited effectiveness of these interventions, we then introduced the parent-led intervention. The parent-led intervention was very effective in reducing negative vocalizations (*M* = 23.60%) and increasing head elevation (*M* = 55.45%) for six of the seven participants (i.e., all participants except Sean). These results suggest that commonly recommended interventions for tummy time on the floor, such as providing a toy and/or interacting with the infant, might not produce socially-significant behavior change for many infants.

We also assessed the mothers' satisfaction with the effect of the interventions on their infants' behavior by way of a Social-Validity Questionnaire. Five of the mothers completed the questionnaire (mothers of Marie, Therese, Sean, Edward, and Charles), and collectively, the mothers reported greater satisfaction with how the parent-led sessions helped reduce their infants' negative vocalizations and increase their head elevation, compared to the experimenter-led sessions. Specifically, all mothers (except Sean's mother) reported that they "strongly agreed' that they were satisfied with how the parent-led sessions helped (a) reduce their infants' negative vocalizations and (b) increase head elevation, compared to only two mothers who reported that they "strongly agreed" that they were satisfied with the how the experimenter-led sessions reduced negative vocalizations and increased head elevation. Although for most participants the experimenter-led interventions were associated with *some* reduction in negative vocalizations and increase in head elevation, these results validate that these interventions did not produce socially-significant changes in the infants' behavior. Rather, for all

mothers but Sean's, they strongly agreed that the parent-led intervention was effective in reducing negative vocalizations and increasing head elevation for their infants.

The results of the current experiment differ from that of Kadey and Roane (2012) and Ortega and Fienup (2015) in that our interventions on the floor were not very effective in reducing negative vocalizations or increasing head elevation. However, there are several differences between our studies that may explain the discrepant findings. First, unlike these two other studies, we did not conduct a preference assessment to identify the toy to be used in sessions. Rather than conducting a preference assessment and individualizing toys to use in our experimenter-led sessions, we elected to use the tummy-time mat because such mats are marketed for tummy time, yet their effectiveness has yet to be examined prior to this experiment. We did individualize toys that the mothers showed their infants in the parent-led sessions, but did so by way of having the mothers identify what toys their infants seemed to engage with the most. Research with individuals with disabilities suggests that caregiver report of an individuals' preference may not match one's actual preference as determined by a preference assessment (e.g., Green, Reid, White, Halford, & Brittain, 1988), so it is possible that these toys used in sessions were not, in fact, preferred items. Had we conducted a formal preference assessment to identify toys to be used in these sessions, we may have seen a greater reduction in negative vocalizations and increase in elevated head. However, doing so would also challenge the degree of face validity in that parents may be unlikely to conduct a formal evaluation of preference.

Second, the discrepant findings between our interventions on the floor and those in the study by Ortega and Fienup (the only other study to assess the effects of interaction

on infant behavior during tummy time) may be explained by who was interacting with the infant during sessions. Ortega and Fienup had the infant's mother deliver attention while the infant had tummy time on the floor, whereas we had the experimenter deliver attention. Several studies have found that infants prefer their mother's face and voice compared to that of unfamiliar adults (e.g., DeCasper & Fifer, 2005, Thompson & Trevathan, 2009), thus, had the infants' mothers provided interaction on the floor instead of the experimenter, we may have seen a greater reduction in negative vocalizations and increase in elevated head. Moreover, one major limitation of our study is that we did not conduct a component analysis to identify the most salient features of the parent-led intervention. As we did in the experimenter-led sessions, future research should evaluate the individual and combined effectiveness of *parent* interaction, toys, and the incline position on infant behavior during tummy time. However, because parents can become very distressed by infant fussing, we opted to arrange what we hypothesized to be the most powerful and effective intervention package first, before exposing infant behavior to less-effective methods.

In addition to conducting component analyses to determine the effectiveness of interaction (i.e., from both familial and non-familial caregivers), toys, and the incline position on infant behavior during tummy time, future research should evaluate if there are disparate developmental gains associated with different non-supine positions. That is, the current literature on the developmental benefits of tummy time does not parse out time participants spent in different types of prone positions, such as prone on the floor (e.g., on a tummy-time mat), on caregiver's chest, being held in the tummy-down position, or across a caregiver's lap. Such differences in developmental gains—should

they exist—have implications for caregiver education on tummy-time activities.

To highlight another popular carrying method, some caregivers may also elect to "babywear" instead of placing their infants in the fully prone position on the floor or another surface (e.g., their chests or laps), but the developmental benefits of babywearing compared to tummy time are unknown. For example, Sean's mother commented that, "…one reason [participant's real name]'s neck muscles developed on time was due to baby wearing which was recently found to build the same muscles instead of tummy time which I didn't subject him to as often as is recommended." Many non-reputable sources on the Internet do claim that babywearing "counts as" or "doubles as" tummy time. For instance, one website for one infant-carrier manufacturer claims,

> Babywearing works the same muscles and allows the same benefits as tummy time. An infant in an upright carrier is able to work on moving his or her neck while building up the muscles, and just having to remain upright (even while supported) builds the stomach muscles. (Cassells, 2013)

Although many parenting blogs (e.g., Minnesota Parent; Wittes, 2014), infant carrier websites (e.g., ErgoBaby™; Cassells, 2013), and babywearing websites (Babies in Arms, no date) make similar claims, no reputable source to my knowledge claims that babywearing or carrying one's infant can take the place of tummy time on the floor or on another surface (e.g., parent's chest). The AAP (2017c) does recommend carrying one's baby to help prevent plagiocephaly, but does *not* suggest that babywearing is associated with the same developmental gains as tummy time. Additionally, there are no studies to my knowledge that have examined outcomes associated with positioning in prone for play to time spent upright in an infant carrier. Future research should compare the time

infants spend in a variety of non-supine positions (e.g., on floor, on incline on parent's chest) and the impact of these different positions on gross-motor development. In the meantime, given the preponderance of non-peer-reviewed information on the Internet regarding how babywearing can replace tummy time, the AAP and other reputable sources may wish to consider providing a stance on the lack of evidence to date on this matter.

The results of Experiment 2 have several additional implications for research and practice. First and foremost, the results suggest that commonly recommended activities for tummy time on the floor, such as providing toys or interaction, may not be efficacious interventions for many infants. Although our study was limited to seven infants, none of our interventions on the floor were associated with socially significant behavior change *for any of our participants*. With respect to the provision of toys, our results suggest that products marketed for tummy time (e.g., tummy-time mats) may have limited or no effectiveness of infants' behavior during tummy time. Despite laying infants on a tummy-time mat and providing additional stimulation (e.g., mirrors, contrasting colors) directly in front of the infants, this stimulation was associated with limited effectiveness in decreasing negative vocalizations and increasing head elevation. With respect to interaction, our results suggest that parents whose infants do not tolerate tummy time should try positioning their infants chest to chest, while the parent lies on an incline and interacts with his/her infant and shows him/her toys. This position and stimulation may prove efficacious for decreasing negative vocalizations and increasing head elevation.

With respect to providing interaction on the floor, although interaction on the floor from the participants' mothers may have been more effective, our experimenter-led

interventions are analogous to a non-familial adult, such as a childcare provider, conducting tummy time with an infant. As it is estimated that greater than one-third of infants are cared for by non-familial adults during the day (US Census Bureau, 2013), it is important to identify effective tummy-time interventions that do not require interaction from a parent. As a first step, future research should evaluate the effectiveness of the incline position while a non-familial adult interacts with infants, chest-to-chest, and/or shows them preferred toys.

Second, our results suggest that many infants may not be able to tolerate bouts of tummy time as long as 5 min. That is, for nearly all of our participants, the experimenter had to terminate more than half of the sessions early due two-consecutive min of negative vocalizations (or 1 min of negative vocalizations for Edward). Overall, less parent-led sessions were terminated early compared to experimenter-led sessions. We selected session duration of 5 min given the AAP (2008, 2017a) recommendation to conduct tummy time "2 to 3 times a day for a short period of time (3 to 5 minutes) increasing the amount of time as the baby shows he enjoys the activity" (p. 2). However, caregivers may wish to consider conducting tummy time for shorter bouts (e.g., 1 to 2 min) and then increase the amount of tummy time if negative vocalizations remain low. Conducting tummy time for relatively shorter durations may not only prove to be beneficial for infants, but their caregivers as well. Edward's mother reported such emotional distress hearing her infant cry for 2-consecutive min that we decided to reduce the termination criterion for him to 1 min of negative vocalizations. Thus, shorter bouts of tummy time (e.g., 1 to 2 min) may result in increased infant tolerance, which in turn may positively impact caregiver distress and willingness to conduct tummy time.

Third, our social-validity results further substantiate that tummy time may not only be a challenge for infants, but for their caregivers. Three of the five mothers reported that, prior to the start of the study, it was emotionally difficult for them when their infant cried during tummy time. Also, four of the five mothers also reported that (a) they would terminate tummy time by picking their infants up shortly they started crying (i.e., within 30 s of crying) and (b) their infant's crying made them reluctant to conduct tummy time. That is, both escape and avoidance may be types of negative reinforcement at work that influence caregiving behaviors with respect to tummy time. The role of negative-reinforcement contingencies in terminating infant crying has been previously documented (e.g., Thompson, Bruzek, & Cotnoir-Bichelman, 2011). The social-validity data provide further evidence that caregivers' behavior with respect to tummy time (e.g., repositioning the infant) may be negatively reinforced because these behaviors may terminate or attenuate infants' cries. For instance, Edward's mother commented,

> Before the study, I was putting my baby on his tummy and when he cried, I would quickly pick him up or put him on his back. The study helped me work through the emotional reaction to my baby's crying and ultimately helped him tolerate his tummy better.

Edward's mother's comments suggest her repositioning Edward to the supine position from the prone position was negatively reinforced, in that her repositioning him terminated his cries (i.e., "escape" was the mechanism at work). Additionally, Sean's mother reported that after the study, Sean continued to cry "all of the time" when she did tummy time with him, and indicated that given his continued crying, she did not implement tummy time "consistently or very frequently." Sean's mother also

commented,

> I understand the value of tummy time but felt it was too stressful for him (and me) and was not worth the unhappiness it produced. For future children I will continue to offer tummy time, but limit it greatly for those who fervently dislike it as much as [participant's real name].

Additionally, Charles' mother commented,

> Before my son participated in the study, I was incredibly reluctant to put him down for tummy time due to the frequency of his crying. I also felt less confident putting him down for tummy time and often felt nervous about letting him cry.

Sean's mother's and Charles' mother's comments point to how caregivers may not only terminate tummy time if their infants cry, but they may also not *initiate* tummy time because, historically, initiating tummy time may be associated with the onset of crying. In highlighting research by Piazza et al. (2003), Kadey and Roane (2012) note that, "caregivers may avoid putting children in a seemingly aversive situation because of the negative side effects for the child (e.g., crying) or the hypothesized effects this interaction may have on the relationship with the child." (p. 397-398). In light of attachment theory (e.g., Bell & Ainsworth, 1972), caregivers, in particular mothers, may perceive infants' cries during tummy time as "signaling behaviors" that require their responsiveness. By initiating tummy time or not terminating tummy time immediately once their infants begin to cry, caregivers may worry that they may disrupt the bond with their child.

Three of the four mothers of infants for whom the parent-led intervention was very effective reported that they "strongly agreed" that they were more likely to conduct tummy time following the termination of the study. Although increased likelihood to

conduct tummy time may be a by-product simply of increased *knowledge* about the importance of providing tummy time, it is possible that the mothers were more likely to conduct tummy time because of increased infant *tolerance*. The mothers' responses to other questions support this claim; for all mothers but Sean's mother, each also reported that their infants cried only some of the time (3 of the 4 mothers) or not at all (1 mother) and that they lifted their heads most of the time (2 mothers) or all of the time (2 mothers). Taken as a whole, the social-validity survey data further bolster the importance of identifying effective interventions for tummy time, as effective increased tolerance to tummy time may be associated with positive emotional benefits for caregivers (e.g., decreased distress) as well as increased likelihood of providing tummy time. In turn, if caregivers are more likely to conduct tummy time, increased time spent in the prone position for play may be associated with developmental gains.

Chapter 5: General Discussion

The results of these two experiments provide additional evidence to support the importance of caregiver education about safe sleep and tummy time as well as the identification of effective interventions to increase infants' tolerance of tummy time. The results of Experiment 1 suggested that current parents and first-time, expectant parents from both high- and low-SES backgrounds lack knowledge about safe sleep and tummy time, and that the video we created specifically for this study was an effective educational tool for all groups. The results of Experiment 2 suggested that commonly recommended interventions for tummy time on the floor (e.g., providing toys, interacting with the infant) may not be very effective in reducing crying or increasing head elevation, for some infants. The results of Experiment 1 and 2 have implications for research and practice. In particular, our results point to three critical needs beyond just educating current parents about safe sleep and tummy time: (a) *prenatal* education about safe sleep and tummy time, (b) additional support for parents to keep their infants sleeping safely *and* soundly, and (c) additional support to help parents whose infants may be intolerant of tummy time. A common theme in Experiment 1 and 2 was the role of infant behavior (e.g., crying) on caregiving behavior (e.g., positioning in prone for sleep, not conducting tummy time). These results have several implications for research, practice, and public policy, and suggest that safe sleep and tummy time education may be a ripe area for behavior analysis.

The results of Experiment 1 have implications for health-care providers and the timing of safe sleep and tummy time education. The results of Experiment 1 suggest timing of safe-sleep and tummy-time education should occur *early* (i.e., during

pregnancy). It was concerning that 20% of participants reported that they never received information about safe sleep, and 28.33% reported never receiving information about tummy time. Most of the participants who reported never receiving information were first-time, expectant parents. To focus on safe sleep, preparing a safe-sleep environment may take time and resources, so timing of safe-sleep education early in one's pregnancy may be important. Additionally, this earlier timing of safe-sleep education is critical given additional practices that are associated with a reduced risk of SIDS, as well other infant health outcomes. For instance, the AAP (2016) also recommends that (a) expectant mothers receive regular prenatal care, (b) mothers exclusively breastfeed for at least six months, unless contraindicated, and (c) parents avoid smoke exposure during pregnancy and after the infant's birth.

As a first approach and a public policy matter, educating expectant parents of the importance of attending prenatal care appointments (and providing low- or no-cost care to those who cannot afford coverage) is critical. Then, prenatal appointments that begin *early* in the pregnancy and continue until the baby is born can be the gateway for disseminating information about preparing a safe-sleep environment, breastfeeding after the infant is born, the importance of avoiding smoke exposure for the duration of the pregnancy and after the infant is born, and tummy time. Some of these practices may require substantial effort and resources to be successful (e.g., acquiring a crib and preparing a safe-sleep environment, attending programs or classes on breastfeeding or smoking cessation), so education as early as possible in a woman's pregnancy may be optimal to ensure success. As noted by Chang et al. (2013), and supported by other research on obstetric providers' smoking-cessation counseling practices, (e.g., McBride,

Emmons, & Lipkus, 2003), "Pregnancy can be a 'teachable moment,' a time during which women are more receptive to behavior change" (p. 2).

Next, two key findings from Experiment 1 indicate that parents may need additional *support* to help ensure their infants sleep safely, beyond just providing education: (a) a subset of participants reported that a doctor would say infants should sleep on their backs, but despite this knowledge, they reported that they positioned or planned to position their infants on their tummies, side, or whichever position they were most comfortable, and (b) the top reason for unsafe positioning for sleep at naps and at night was "my baby likes/will like it best." This last finding is in line with other research that has identified that infant preference and/or better infant sleep is a top reason for positioning infants in prone for sleep (e.g., Willinger et al., 2000). These aforementioned findings are alarming, as they suggest that despite efforts to teach parents and expectant about safe-sleep practices, the infant's behavior—such as less frequent night wakings, less negative vocalizations, longer sleep duration—may dictate parents' choice of sleep position or other sleep practices (e.g., bedsharing).

Although the percentage of participants in our study who reported bedsharing was relatively low compared to other studies, it may be particularly important for practitioners and researchers to focus on identifying effective ways to educate and support parents who bedshare with their infants given recent national trends in bedsharing. From 1993 to 2010, rates of bedsharing doubled, and increased among *all* races (Colson et al., 2013). With the rise in bedsharing, rates of deaths due accidental suffocation or strangulation began increasing in 1997 and reached their highest rate in 2015 (CDC, 2018). A review of the data from the National Center for the Review and Prevention of Child Death Case

Reporting System identified that 69% of sleep-related infant deaths were associated with bedsharing, making it the greatest risk factor for sleep-related infant death (Colvin, Collie-Akers, Schunn, & Moon, 2014). Accidental suffocation and strangulation in bed is *preventable*, and understanding parents' reasons for bedsharing is critical in order to address prevention of these deaths.

As we found with participants' reasons for placing their baby in non-supine positions, mothers' reasons for bedsharing with their infants have been also attributed to their infants' behavior. Such reasons include greater perceived infant sleep quality or duration (and better sleep for the parent), and less reported infant crying while bedsharing (Salm Ward, 2014). With respect to infant crying, Salm Ward, in a review of the literature on mothers' reasons for bedsharing, explains that,

> An oft-described scenario was that of an exhausted parent and a crying infant when, out of desperation, the infant was placed in bed with the caregiver, at which time the crying stopped and everyone obtained much-needed sleep (p. 682).

Salm Ward also identified other reasons for bedsharing, such as environmental reasons (e.g., no crib, protection from perceived dangers, warmth), a way to monitor the infant closely, cultural or familial tradition, convenience with breastfeeding, providing comfort for the infant, disagreement of the dangers of bedsharing (e.g., parents were "light" sleepers and they would never roll onto the infant), or parenting beliefs (e.g., "attachment parenting") associated with the importance of bedsharing for bonding. As infant behavior is associated with parents engaging in sleep practices *that place infants at risk for death*, it is imperative that researchers (e.g., behavior analysts) help support parents by addressing such infant and parent behavior.

To be best support parents, providers should understand the fluidity of sleep throughout the night (Batra et al., 2016), ask parents about the infants' behavior for sleep at naps *and* at night, and inquire about parents' reasons for certain sleep practices (e.g., location, position, use of objects that could put infant at risk for suffocation or strangulation). Such support may involve helping parents identify ways that they can be conveniently near their infant for breastfeeding, comforting, and monitoring (e.g., a bassinet or portable crib placed next to the parents' bed), and teaching parents strategies that can help facilitate sleep throughout the night. To my knowledge, there is no research to date that has examined whether teaching parents strategies (e.g., establishing a routine, providing white noise, swaddling) may be associated with better infant sleep, *but also* greater parental adherence to safe-sleep guidelines. Given the frequency with which participants in our study and others (e.g., Willinger et al., 2000) reported unsafe practices because of greater perceived infant preference, comfort, or sleep quality, it is important that safe-sleep education also include a supportive component, in which providers help parents address infant behavior and mitigate other such challenges to safe-sleep implementation.

As with safe sleep, the results of Experiment 1 also suggested that caregiver education *and* support about tummy time is needed. There were a few findings that suggested that simply educating parents about the importance of tummy time may be insufficient: (a) infant intolerance of tummy time was a common caregiver barrier to implementing tummy time, (b) many parents reported that they were *worried* about conducting tummy time because of infant intolerance of the position, (c) only about one-third of participants identified things that a parent could do to help an infant enjoy tummy

time. In addition to providing caregiver education about tummy time as we did in Experiment 1, these results further support the need for research on interventions to help infants enjoy tummy time and to educate caregivers about the importance varying infants' positions throughout the day. Other research has identified that interventions like feedback and self-monitoring may be effective in increasing the variety of positions in which childcare providers place infants (e.g., Cotnoir-Bichelman, Thompson, McKerchar, & Haremza, 2006).

Our findings with respect to tummy time have some additional implications for health-care providers. First, as our results and others (e.g., Davis et al., 1998; Salls et al., 2002; Zachry & Kitzmann, 2011) suggest that infant intolerance of tummy time is a deterrent of conducting tummy time, greater emphasis needs to be placed on ways to support caregivers should their infants not tolerate tummy time. Such support should include recommendations for other ways to conduct tummy time to help the infant tolerate the position. For example, Zachry and Kitzmann suggest that educators explain to caregivers that, at first, their infant may not tolerate tummy time, and that "suggestions to motivate the infant to tolerate the prone position would also be beneficial, such as getting at the infants' eye level and communicating by making faces, singing, talking, and the like" (p. 104) and that,

> Parents should be informed that initial exposure to prone positioning can be implemented in a variety of ways, such as placing the baby on the caregiver's chest when the caregiver is in a reclined position, placing the baby on the caregiver's lap, holding and carrying the infant in a prone position, and burping the baby in a prone position on the caregiver's lap (p. 104).

As previously noted, research by Koren and colleagues (2010) suggested that although health-care providers discussed SIDS prevention at each well-child visit, they provided informal, "random" counseling about tummy time beginning when the child was 2 to 3 months of age. Not only may the timing of such education be too late, such informal, "random" counseling may not include information about how to help increase infants' tolerance for tummy time. As a result of providing parents additional guidance about different (and perhaps more effective) ways to conduct tummy time, infants may experience greater tolerance. In turn, infant tolerance of tummy time may be associated with caregivers placing their infants in prone for play more frequently and/or for longer durations, which may be associated with developmental gains.

Taken as a whole, the results of Experiment 1 and 2 have additional implications for policy makers. In response to a spike in sleep-related infant deaths in 2017, Leana Wen, the Baltimore City Health Commissioner commented in an April 2017 press release that:

> Even one baby dying is one baby too many. We need everyone to help us spread the word about the ABCs of Sleep: babies should be put to sleep Alone, on their backs, in cribs, no smoking, and no exceptions. As an expecting mother, I know that women receive all types of conflicting advice, so we want to be clear: we can save lives by following these simple, science-based ABCs of Safe Sleep. We have a moral imperative to ensure that families have the knowledge and resources so that babies can thrive.

Dr. Leana Wen's statement underscores the importance of continued funding for research and educational interventions on safe sleep and tummy time. Behavior analysts may be

particularly suited to help address some of the behavioral challenges that may serve as barriers to the implementation of safe sleep and tummy time. However, behavior analytic services are often compensated through managed-care organizations and there is not currently coverage to provide behavioral assessment and treatment for infant sleep or tummy time, and such behavioral interventions for addressing sleep disturbances in young children have been efficacious (e.g., Jin, Hanley, & Beaulieu, 2013). Addressing infant behavior may be particularly important, as our research and others have identified that infant behavior (e.g., perceived infant preference, night waking) is the #1 reason that parents engage in risky sleep practices with their infants. Additionally, these practices currently constitute a large percentage of the *preventable* sleep-related infant deaths each year. There are perhaps very few initiatives more worthy of resources than safe-sleep initiatives, as infant sleep is associated with thousands of fatalities each year, and preventable deaths due to accidental suffocation and strangulation in bed are now on the rise. It is also particularly important that initiatives assist parents from disadvantaged populations who may lack the resources needed to support their safe-sleep efforts, such as access to quality healthcare and education. In effort to prevent the approximately 3,500 sleep-related infants deaths that occur annually, additional funding, research, and caregiver education and support is clearly needed.

Appendices

Appendix A: AAP Safe-Sleep Policy Statement Recommendations

Recommendation or Noted Risk factors	*1992*	*1996*	*2000*	*2005*	*2016*
		Safe-Sleep Positioning			
Supine positioning for sleep	Yes	Yes Specified that supine-sleeping recommend-ations are for healthy infants only	Yes	Yes	Yes
Lateral positioning for sleep	Yes	Amended; Recommended supine position as lowest-risk position	---	---	---
		Safe-Crib Environment and Other Risk-Reduction Practices for Caregivers and Providers			
Provide baby with separate, flat surface for sleep (i.e., crib, bassinet, or play yard that meets safety standards)	---	---	Yes	Yes	Yes; and multiples should not be co-bedded
Avoid soft surfaces and gas-trapping objects (e.g., blankets, pillows, stuffed animals)	---	Yes	Yes	Yes	Yes; also pointed out dangers of bumper pads
Provide tummy time	---	Yes	Yes	Yes	Yes
Use crib that conforms to current safety standards	---	---	Yes	Yes	Yes
Avoid using any sitting devices (e.g., car seats, infant carriers, swings) for routine sleep	---	---	---	---	Yes

Do not place infants on soft surfaces for sleep	---	---	Yes	Yes	Yes
Avoid bed sharing	---	---	Yes	Yes	Yes
Practice roomsharing without bedsharing	---	---	---	Yes	Yes; noted ideally roomsharing should be done for 1 year, but at least 6 months
Breastfeed infant	---	---	---	---	Yes
Avoid overheating by lightly clothing infant and keeping room temperature comfortable	---	---	Yes	Yes	Yes
Avoid devices designed to maintain sleep position or reduce risk of rebreathing	---	---	Yes	Yes	Yes
Be aware that cardiac and respiratory monitors lack evidence that they reduce incidence of SIDS	---	---	Yes	Yes	Yes
Avoid maternal smoking during pregnancy and exposure to second-hand smoke	---	---	Yes	Yes	Yes
Avoid alcohol and illicit drug use during pregnancy and after birth	---	---	---	---	Yes
Receive regular prenatal care during pregnancy	---	---	---	---	Yes
Immunize infants according to AAP and CDC recommendations	---	---	---	---	Yes
Health and child care providers should endorse SIDS risk-reduction recommendations	---	---	---	Yes	Yes
Provide pacifier at night (after one-month of age for breastfed infants)	---	---	---	Yes	Yes
Avoid excessive time in car-seat carriers and bouncers	---	---	---	Yes	Yes

Appendix B: Summary of Described Assessment Tools

Name of Tool	Author	Ages	Domains
Alberta Infant Motor Scale (AIMS)	Piper and Darrah (1994)	Birth to 18 months	Gross motor; 58 items: prone (21 items), supine (9 items), sitting (12 items), and standing milestones (16 items)
Denver Developmental Screening Test- Revised	Frankenburg, Dodds, and Archer (1992)	Two weeks to 6 years	Personal-Social, Fine Motor/Adaptive, Language, Gross Motor; 125 total items
Peabody Developmental Motor Scale (PDMS)	Folio & Fewell (1983)	Birth to 5 years	Fine and gross motor; Six subtests which include reflexes (8 items), stationary control (30 items), locomotion (89 items), object manipulation (24 items), grasping (26 items), and visual-motor integration (72 items)

Appendix C: Summary of Studies on the Effects of Sleep Positioning on Development

Study	Reference	Groups	Measure(s)	Principle Finding(s)
Jantz, Blosser, and Fruechting (1997)	257 infants; retrospective chart review of development at 4- and 6-month well-child visit	Supine, prone, and side-lying sleepers	Denver Developmental Screening Test- Revised	Four-month olds who slept supine or side-lying less likely to roll compared to prone sleepers; No significant differences at 6 months

Davis, Moon, Sachs, and Ottolini (1998)	351 infants followed from first week of life until 6-months of age	Supine, prone, and side-lying sleepers	Developmental log about motor skills	Prone sleepers acquired milestones (rolling to supine, sitting tripod, creeping, crawling, and pulling to stand) earlier than those who slept supine
Dewey, Fleming, and Golding (1998)	10,000 infants followed from 4 weeks of age to 18 months of age	Supine, prone, and side-lying sleepers	Questions derived from Denver Developmental Screening Test- Revised	Infants placed in prone to sleep were significantly more likely than supine sleepers to have a higher gross motor and total score at 6-months of age; no significant differences at 18-months of age

Appendix D: Summary of Studies on the Effects of Positioning for Tummy Time on Development

Study	Reference	Groups	Measure(s)	Principle Finding(s)
Salls, Silverman, and Gatty (2002)	66 infants examined at the 2-, 4-, and 6 month well-child visits	Supine and side-lying sleepers (compared to norm reference group on measures)	Milestones from the gross motor sector of the Denver Developmental Screening Test-Revised	No significant differences in milestone attainment between supine and side-lying sleepers Two-month old infants who had ≥15 min tummy time each day less likely than the normative population to pass the following milestones: head up 45°, head up 90°, and sit with head steady; no significant differences at 4- and 6-months of age between the sample and norm reference group

Majnemer and Barr (2005)	71 4-month old infants, 50 6-month old infants	Supine sleepers (compared to norm reference group on measures)	Alberta Infant Motor Scale Peabody Developmental Motor Scale Amount of tummy time each day	Four- and 6-month olds supine sleepers less likely to achieve certain gross motor milestones as compared to norm-reference group Amount of tummy time positively associated with fine and gross motor development
Dudek-Shriber and Zelazny (2007)	100 4-month old infants	Categorized based on the amount of time spent in supine, side-lying, and prone for sleep and for play	Alberta Infant Motor Scale Amount of tummy time	Time spent awake in the prone position significantly predicted gross motor achievement on seven of the 21 prone milestones, three of the nine supine milestones, and three of the 12 sitting milestones on AIMS; significant differences associated with greater than 1 hr 21 min of tummy time

Appendix E: Demographic and Personal Practices Questionnaire

(Expectant Parents Only)

Please answer the following questions to the best of your knowledge.

1. Please tell us a little bit about yourself.
    a. I am pregnant with my first child.
    b. My significant other is pregnant with my first child.

2. If pregnant, how pregnant are you or your significant other?
    a. Under 12 weeks pregnant
    b. 12 to 15 weeks pregnant
    c. 16 to 19 weeks pregnant
    d. 20 to 23 weeks pregnant
    e. 24 to 27 weeks pregnant
    f. 28 to 31 weeks pregnant
    g. 32 to 35 weeks pregnant
    h. 36 to 39 weeks pregnant
    i. 40 weeks or more pregnant

3. Are you male or female?
    a. Male
    b. Female

4. Your marital status:
    a. Single
    b. Living with significant other
    c. Married
    d. Separated or divorced
    e. Widowed

5. How old are you?
    a. 13 to 17
    b. 18 to 24
    c. 25 to 34
    d. 35 to 44
    e. 45 to 54
    f. 55 to 64
    g. 65 to 74
    h. 75 or older

6. What is your yearly total household income?
    a. Less than $15,000
    b. $15,000 to $30,000
    c. $30,000 to $45,000
    d. $45,000 to $60,000
    e. $60,000 to $75,000
    f. $75,000 to $90,000
    g. More than $90,000

7. What type of insurance do you have?
    a. Private insurance
    b. Medical Assistance
    c. I currently do not have insurance

8. What is the highest grade or level of school that you have completed?
    a. 8th grade or less
    b. Some high school but did not graduate
    c. High school degree or equivalent (e.g., GED)
    d. Some college or 2-year degree
    e. 4-year college graduate
    f. More than 4 years of college
    g. Graduate degree

9. A. Do you work with children 3 years of age and under or have you worked with children 3 years of age and under?
    a. Yes (please also answer 9 B below)
    b. No

    B. If yes, what is (or was) your profession (circle all that apply)?
    a. Childcare Provider
    b. Nanny
    c. Nurse
    d. Occupational Therapist
    e. Physical Therapist
    f. Physician (e.g., pediatrician, developmental pediatrician, family practitioner)
    g. Psychologist
    h. Service Coordinator/Case Manager
    i. Special Education Teacher
    j. Speech and Language Pathologist
    k. Teacher (e.g., preschool teacher, Early Head Start teacher)
    l. Other (please specify): _____

10. Which race/ethnicity describes you?
    a. American Indian or Alaskan Native
    b. Asian or Pacific Islander
    c. Black or African American
    d. Hispanic or Latino
    e. White / Caucasian
    f. Prefer not to answer

11. Please tell us a little about where you live.
    Zip/Postal Code: _____

12. When did you receive information regarding SAFE SLEEP?
    a. I never received information about safe sleep
    b. Before pregnancy
    c. During pregnancy
    d. I know that I received information but don't remember when

    If you received information about safe sleep, what source provided you with the most information regarding SAFE SLEEP?
    a. Parents or grandparents
    b. Other family members
    c. Friends
    d. Internet
    e. Books or other print resources
    f. Television or DVDs
    g. Obstetrician or nurse midwife
    h. Pediatrician or family physician
    i. Other (please specify): _____

13. When did you receive any information regarding TUMMY TIME?
    a. I never received information about tummy time
    b. Before I was pregnant
    c. While I was pregnant
    d. I know that I received information but don't remember when

    If you received information about tummy time, what source provided you with the most information regarding TUMMY TIME?
    a. Parents or grandparents
    b. Other family members
    c. Friends
    d. Internet
    e. Books or other print resources
    f. Television or DVDs
    g. Obstetrician or nurse midwife
    h. Pediatrician or family physician
    i. Other (please specify): _____

14. Parents may receive information about positioning babies for SLEEP from a variety of sources. Please rank the THREE sources you value most for information about positioning for SLEEP, with 1 being the most valued source, 2 being the second most valued source, and 3 being the third most valued source.

_____ Parents or grandparents
_____ Other family members
_____ Friends
_____ Internet or smartphone application
_____ Books or other print resources
_____ Television or DVDs
_____ Obstetrician or nurse midwife
_____Pediatrician or family physician
_____ Nurse or other health professional

15. Parents may receive information about TUMMY TIME from a variety of sources. Please rank the THREE sources you value most for information about TUMMY TIME, with 1 being the most valued source, 2 being the second most valued source, and 3 being the third most valued source.

_____ Parents or grandparents
_____ Other family members
_____ Friends
_____ Internet or smartphone application
_____ Books or other print resources
_____ Television or DVDs
_____ Obstetrician or nurse midwife
_____Pediatrician or family physician
_____ Nurse or other health professional

16. WHERE do you *plan* to place your baby to sleep *FOR NAPS*?
    a. On my chest (either being held on chest or in infant wrap/carrier)
    b. In my arms
    c. In a bed
    d. In swing
    e. In an infant seat (e.g., vibrating seat, bouncy seat)
    f. In Pack N' Play
    g. In a crib
    h. Bassinet
    i. Wherever baby is most comfortable
    j. Not sure
    k. Other (please specify): _____

17. WHERE do you *plan* to place your baby to sleep *AT NIGHT*?
    a. On my chest (either being held on chest or in infant wrap/carrier)
    b. In my arms
    c. In a bed
    d. In a swing
    e. In an infant seat (e.g., vibrating seat, bouncy seat)
    f. In a Pack N' Play
    g. In a crib
    h. In a bassinet
    i. Wherever baby is most comfortable
    j. Not sure
    k. Other (please specify): _____

18. In what POSITION do you *plan* to place your baby to sleep *FOR NAPS*?
    a. On tummy
    b. On back
    c. On side
    d. Whichever position he/she is most comfortable
    e. Not sure

19. What was your <u>main reason</u> for placing the baby in the position you noted above *FOR NAPS*?
    a. Fear of baby choking
    b. Fear of baby suffocating
    c. Fear of sudden infant death syndrome
    d. My parents or grandparents told me to
    e. My friend told me to
    f. My baby will like it best
    g. The doctor said to
    h. Other (please specify): _____

20. In what POSITION do you *plan* to place your baby to sleep *AT NIGHT*?
    a. On tummy
    b. On back
    c. On side
    d. Whichever position baby is most comfortable
    e. Not sure

21. What was your <u>main reason</u> for placing the baby in this position you noted above for sleep *AT NIGHT*?
    a. Fear of baby choking
    b. Fear of baby suffocating
    c. Fear of sudden infant death syndrome
    d. My parents or grandparents told me to
    e. My friend told me to
    f. My baby will like it best
    g. The doctor said to
    h. Other (please specify): _____

22. How much total time, each day, do you *plan* to place your baby on his/her tummy, while awake?
    a. Less than 1 minute
    b. 1 to 5 minutes
    c. 6 to 15 minutes
    d. 16 to 30 minutes
    e. 31 to 60 minutes
    f. 1 to 2 hours
    g. More than 2 hours
    h. All of the time
    i. Not sure

23. How likely would you be to place your baby on his/her tummy if your baby were to cry or fuss while on his/her tummy, while awake?
    a. I would not place my baby on his/her tummy
    b. Unlikely
    c. Somewhat likely
    d. Likely
    e. Very likely

Please use the space below for any comments you may have regarding your above responses.

_____
_____
_____
_____
_____
_____
_____

Thank you!

Appendix F: Demographic and Personal Practices Questionnaire

(Current Parents Only)

Please answer the following questions to the best of your knowledge.

1. Please tell us a little bit about yourself.
    a. I am the mother of a young child.
    b. I am the father of a young child.
    c. I am a grandmother who is the legal guardian of a young child.
    d. I am a grandfather who is the legal guardian of a young child.
    e. I am a legal guardian of a young child, but I am not the grandmother or grandfather.

2. Are you male or female?
    a. Male
    b. Female

3. Your marital status:
    a. Single
    b. Living with significant other
    c. Married
    d. Separated or divorced
    e. Widowed

4. Please list the month and year of your child(ren)'s birthday.
    a. _____(month), _____(year)
    b. _____(month), _____(year)
    c. _____(month), _____(year)
    d. _____(month), _____(year)
    e. _____(month), _____(year)

5. How old are you?
    a. 13 to 17
    b. 18 to 24
    c. 25 to 34
    d. 35 to 44
    e. 45 to 54
    f. 55 to 64
    g. 65 to 74
    h. 75 or older

6. What is your yearly total household income?
    a. Less than $15,000
    b. $15,000 to $30,000
    c. $30,000 to $45,000
    d. $45,000 to $60,000
    e. $60,000 to $75,000
    f. $75,000 to $90,000
    g. More than $90,000

7. What type of insurance do you have?
    a. Private insurance
    b. Medical Assistance
    c. I currently do not have insurance

8. What is the highest grade or level of school that you have completed?
    a. 8th grade or less
    b. Some high school but did not graduate
    c. High school degree or equivalent (e.g., GED)
    d. Some college or 2-year degree
    e. 4-year college graduate
    f. More than 4 years of college
    g. Graduate degree

9. A. Do you work with children 3 years of age and under or have you worked with children 3 years of age and under?
    a. Yes (please also answer 9 B below)
    b. No

    B. If yes, what is (or was) your profession (circle all that apply)?
    a. Childcare Provider
    b. Nanny
    c. Nurse
    d. Occupational Therapist
    e. Physical Therapist
    f. Physician (e.g., pediatrician, developmental pediatrician, family practitioner)
    g. Psychologist
    h. Service Coordinator/Case Manager
    i. Special Education Teacher
    j. Speech and Language Pathologist
    k. Teacher (e.g., preschool teacher, Early Head Start teacher)
    l. Other (please specify): _____

10. Which race/ethnicity describes you?
    a. American Indian or Alaskan Native
    b. Asian or Pacific Islander
    c. Black or African American
    d. Hispanic or Latino
    e. White / Caucasian
    f. Prefer not to answer

11. Please tell us a little about where you live.
    Zip/Postal Code: _____

******We ask that all parents answer the following questions. But, if you have more than one child, please answer the following questions regarding your youngest child.******

12. When did you receive information regarding SAFE SLEEP?
    a. I never received information about safe sleep
    b. Before pregnancy
    c. During pregnancy
    d. Within the first week of my child's life
    e. When my baby was 1 week old to 3 months old
    f. When my baby was older than 3 months old
    g. I know that I received information but don't remember when

    If you received information about safe sleep, what source provided you with the most information regarding SAFE SLEEP?
    a. Parents or grandparents
    b. Other family members
    c. Friends
    d. Internet
    e. Books or other print resources
    f. Television or DVDs
    g. Obstetrician or nurse midwife
    h. Pediatrician or family physician
    i. Nurse at hospital where my baby was born
    j. Other (please specify): _____

13. When did you receive any information regarding TUMMY TIME?
    a. I never received information about tummy time
    b. Before I was pregnant
    c. While I was pregnant
    d. Within the first week of my child's life
    e. When my baby was 1 week old to 3 months old
    f. When my baby was older than 3 months old
    g. I know that I received information but don't remember when

If you received information about tummy time, what source provided you with the most information regarding TUMMY TIME?

a. Parents or grandparents
b. Other family members
c. Friends
d. Internet
e. Books or other print resources
f. Television or DVDs
g. Obstetrician or nurse midwife
h. Pediatrician or family physician
i. Nurse at hospital where my baby was born
j. Other (please specify): _____

14. Parents may receive information about positioning babies for SLEEP from a variety of sources. Please rank the THREE sources you value most for information about positioning for SLEEP, with 1 being the most valued source, 2 being the second most valued source, and 3 being the third most valued source.

_____ Parents or grandparents
_____ Other family members
_____ Friends
_____ Internet or smartphone application
_____ Books or other print resources
_____ Television or DVDs
_____ Obstetrician or nurse midwife
_____ Pediatrician or family physician
_____ Nurse or other health professional

15. Parents may receive information about TUMMY TIME from a variety of sources. Please rank the THREE sources you value most for information about TUMMY TIME, with 1 being the most valued source, 2 being the second most valued source, and 3 being the third most valued source.

_____ Parents or grandparents
_____ Other family members
_____ Friends
_____ Internet or smartphone application
_____ Books or other print resources
_____ Television or DVDs
_____ Obstetrician or nurse midwife
_____ Pediatrician or family physician
_____ Nurse or other health professional

16. From birth to 4 months of age, WHERE did you place your baby to sleep *FOR NAPS,* most of the time?
    a. On my chest (either being held on chest or in infant wrap/carrier)
    b. In my arms
    c. In a bed
    d. In swing
    e. In an infant seat (e.g., vibrating seat, bouncy seat)
    f. In Pack N' Play
    g. In a crib
    h. Bassinet
    i. Wherever baby is most comfortable
    j. Not sure
    k. Other (please specify): _____

17. From birth to 4 months of age, WHERE did you place your baby to sleep *AT NIGHT,* most of the time?
    a. On my chest (either being held on chest or in infant wrap/carrier)
    b. In my arms
    c. In a bed
    d. In a swing
    e. In an infant seat (e.g., vibrating seat, bouncy seat)
    f. In a Pack N' Play
    g. In a crib
    h. In a bassinet
    i. Wherever baby is most comfortable
    j. Not sure
    k. Other (please specify): _____

18. From birth to 4 months of age, in what POSITION did you place your baby to sleep *FOR NAPS* most of the time?
    a. On tummy
    b. On back
    c. On side
    d. Whichever position he/she is most comfortable
    e. Not sure

19. What was your <u>main reason</u> for placing the baby in the position you noted above *FOR NAPS*?
    a. Fear of baby choking
    b. Fear of baby suffocating
    c. Fear of sudden infant death syndrome
    d. My parents or grandparents told me to
    e. My friend told me to
    f. My baby liked it best
    g. The doctor said to
    h. Other (please specify): _____

20. From birth to 4 months of age, in what POSITION did you place your baby to sleep *AT NIGHT,* most of the time?
    a. On tummy
    b. On back
    c. On side
    d. Whichever position baby is most comfortable
    e. Not sure

21. What was your main reason for placing the baby in this position you noted above for sleep *AT NIGHT*?
    a. Fear of baby choking
    b. Fear of baby suffocating
    c. Fear of sudden infant death syndrome
    d. My parents or grandparents told me to
    e. My friend told me to
    f. My baby liked it best
    g. The doctor said to
    h. Other (please specify): _____

22. From birth to 4 months of age, how much total time did your baby spend on his/her tummy while awake, each day?
    a. Less than 1 minute
    b. 1 to 5 minutes
    c. 6 to 15 minutes
    d. 16 to 30 minutes
    e. 31 to 60 minutes
    f. 1 to 2 hours
    g. More than 2 hours
    h. All of the time
    i. Not sure

23. How likely would you be to place your baby on his/her tummy if your baby were to cry or fuss while on his/her tummy, while awake?
    a. I would not place my baby on his/her tummy
    b. Unlikely
    c. Somewhat likely
    d. Likely
    e. Very likely

24. How did your baby seem to like being placed on his/her TUMMY while awake?
    a. Seemed to like it
    b. Seemed to neither like or dislike it
    c. Sometimes liked it and sometimes disliked it
    d. Seemed to dislike it (cried/resisted)
    e. I cannot remember

25. How did your baby like being placed on his/her BACK while awake?
    a. Seemed to like it
    b. Seemed to neither like or dislike it
    c. Sometimes liked it and sometimes disliked it
    d. Seemed to dislike it (cried/resisted)
    e. I cannot remember

26. Were you ever worried about putting your baby on his/her tummy while awake? If so, please select the main reason for your concern. Please skip if this does not apply to you.
    a. My baby cried or was fussy while on tummy and did not seem to enjoy it
    b. Fear of baby choking
    c. Fear of baby suffocating
    d. Fear of sudden infant death syndrome
    e. My parents or grandparents told me not to put baby on tummy while awake
    f. My friends told me not to put baby on tummy while awake
    g. My doctor told me not to put baby on tummy while awake
    h. I did not have time
    i. Other (please specify): _____

Please use the space below for any comments you may have regarding your above responses.

_____
_____
_____
_____
_____
_____
_____

Thank you!

Appendix G: Pre- and Post-Test Questionnaires for Both Groups

1. How much do you think you know about SAFE SLEEP from a scale of 1 to 10?
   1 (I know nothing about SAFE SLEEP)
   2
   3
   4
   5
   6
   7
   8
   9
   10 (I know a lot about SIDS)

2. How much do you think you know about TUMMY TIME from a scale of 1 to 10?
   1 (I know nothing about tummy time)
   2
   3
   4
   5
   6
   7
   8
   9
   10 (I know a lot about tummy time)

3. Which of the following things are recommended for SAFE SLEEP? Please circle ALL that you believe are SAFE FOR SLEEP.
   a. Pillows in baby's sleep area
   b. Blanket on baby or in baby's sleep area
   c. Stuffed animals in baby's sleep area
   d. Crib bumpers or other padding along side of crib
   e. Sleeping in a bed
   f. Sleeping on a couch
   g. Sleeping in a crib with a firm mattress
   h. Sleeping on or next to a sleeping adult
   i. Bedroom that is too hot
   j. Too much clothing on the infant that makes him/her hot
   k. Smoking in the home
   l. Pacifiers
   m. Breastfeeding
   n. All of the above
   o. None of the above
   p. Not sure

4. Which of the following things are UNSAFE FOR SLEEP? Please circle all that you believe are UNSAFE FOR SLEEP.
    a. Pillows in baby's sleep area
    b. Blanket on baby or in baby's sleep area
    c. Stuffed animals in baby's sleep area
    d. Crib bumpers or other padding along side of crib
    e. Sleeping in a bed
    f. Sleeping on a couch
    g. Sleeping in a crib with a firm mattress
    h. Sleeping on or next to a sleeping adult
    i. Bedroom that is too hot
    j. Too much clothing on the infant that makes him/her hot
    k. Smoking in the home
    l. Pacifiers
    m. Breastfeeding
    n. All of the above
    o. None of the above
    p. Not sure

5. *WHERE* would a doctor say a baby should sleep for *NAPS* (circle all that apply)?
    a. On my chest (either being held on chest or in infant wrap/carrier)
    b. In my arms
    c. In a bed or a couch
    d. In a swing or in an infant seat (e.g., vibrating seat, bouncy seat)
    e. In a, crib, bassinet, or Pack N' Play
    f. Wherever baby is most comfortable
    g. Not sure
    h. Other: _____

6. *WHERE* would a doctor say a baby should sleep *AT NIGHT* (circle all that apply)?
    a. On my chest (either being held on chest or in infant wrap/carrier)
    b. In my arms
    c. In a bed or a couch
    d. In a swing or in an infant seat (e.g., vibrating seat, bouncy seat)
    e. In a, crib, bassinet, or Pack N' Play
    f. Wherever baby is most comfortable
    g. Not sure
    h. Other: _____

7. *IN WHAT POSITION* would a doctor say you should place your baby <u>to sleep</u> *FOR NAPS* (circle all that apply)?
    a. On stomach
    b. On back
    c. On side
    d. Whichever position he/she is most comfortable
    e. Not sure

8. *IN WHAT POSITION* would a doctor say you should place your baby <u>to sleep</u> *AT NIGHT* (circle all that apply)?
    a. On stomach
    b. On back
    c. On side
    d. Whichever position baby is most comfortable
    e. Not sure

9. Do you know the "ABC's" of safe sleep?
    a. Yes: A stands for __**Alone**_____
    B stands for ____On **Back**_____
    C stands for _____In **Crib**_____
    b. No

10. Is it important for babies to have tummy time?
    a. Yes; if yes, list two reasons why tummy time is important. _
    Answers that received full credit noted both: (a) development (e.g., for muscle development, for achieving milestones like crawling and walking) and (b) for preventing a flat head (i.e., plagiocephaly).
    _____
    _____
    _____
    b. No; if no, why should babies not have tummy time?
    _____
    ____
    c. Not Sure

11. How much tummy time does the American Academy of Pediatrics recommend that babies have each day?
    a. 1-3 minutes, increasing the amount of time as the baby shows that s/he enjoys the activity
    b. 3-5 minutes, increasing the amount of time as the baby shows that s/he enjoys the activity
    c. 5-7 minutes, increasing the amount of time as the baby shows that s/he enjoys the activity
    d. Baby should have tummy time as much as possible, only if s/he enjoys it.
    e. Not sure

12. If a baby does not like tummy time (cries or fusses during tummy time), are there some things that a parent can do to help the infant enjoy tummy time?
    a. Yes; if yes, list 2 things that might help a baby enjoy tummy time.
       Answers that received full credit noted both: (a) interaction and (b) toys or other similar stimulation

       _____
       _____
       _____
    b. No
    c. Not sure

FOR POST-TEST QUESTIONNAIRE ONLY
(DID NOT APPEAR IN PRE-TEST QUESTIONNAIRE):

What three things did you like most about the video and what three things would you change about the video?

I liked:

1. _____
2. _____
3. _____

I would change:

1. _____
2. _____
3. _____

Thank you!

Appendix H: Summary of Experiment 1 Analyses and Findings

Main Analyses	Statistically-Significant Findings	Conclusion	Hypothesis Supported?
	Overall Knowledge and Effectiveness of Video		
Overall knowledge			
Mixed-design ANOVA (a)	Main effect for time and group, and interaction between time and group	Video *was* associated with gains in caregiver knowledge, in particular for expectant parents	Hypothesis 1 was supported because video *was* effective
Descriptive statistics	Differences in knowledge between some of the groups at pre-test, some of which no longer remained at post-test	Video helped close some of the gaps in knowledge that existed between some of the groups at pre-test	
	Incoming knowledge higher for those from high-SES backgrounds, compared to low-SES backgrounds	SES *may* play a role in incoming knowledge (see regression results below)	
Paired-sample t-tests	Increase in knowledge from pre-test for all four groups	The video was associated with gains in knowledge for all groups	
Independent samples t-tests	Difference in pre-test (but not post-test) scores for the parents and expectant parents	Parents had significantly higher incoming knowledge about safe sleep and tummy time	
Mixed-design ANOVA (b)	Interaction for parent type, but not insurance type	The effect of being parent vs. expectant parent—and not SES—drove the interaction between time and group in Mixed Design ANOVA (a)	
	Safe-Sleep and Tummy-Time Knowledge		
Safe-Sleep Items			
Paired samples t-tests	Without regard to group, increase in overall scores of safe-sleep items from pre- to post-test	Video was effective tool for safe-sleep education	
	Difference in pre-test (but not post-test) scores for the parents and expectant parents	Parents *did* demonstrate greater knowledge of safe sleep than first-time, expectant parents; Video helped close	Hypothesis 2 supported because parents *did* demonstrate greater incoming knowledge

		some of the gaps in knowledge that existed between groups	
Descriptive statistics	Within groups, incoming safe-sleep knowledge higher for those from high-SES backgrounds, compared to low-SES backgrounds	SES *may* play a role in incoming knowledge (see regression results below)	
Tummy-Time Items			
Paired samples t-tests	(Same results as in safe sleep t-tests, above): Without regard to group, increase in overall scores of tummy-time items from pre- to post-test Difference in pre-test (but not post-test) scores for the parents and expectant parents	Video was effective tool for tummy-time education Parents *did* demonstrate greater knowledge of tummy time than first-time, expectant parents; Video helped close some of the gaps in knowledge that existed between groups	Hypothesis 3 supported because parents *did* demonstrate greater incoming knowledge
Descriptive statistics	Within groups, incoming tummy-time knowledge higher for those from high-SES backgrounds, compared to low-SES backgrounds	SES *may* play a role in incoming knowledge (see regression results below)	
	Demographic Variables Associated with Incoming Knowledge		
Safe-Sleep Items			
Multiple regression	Main effect for parent type and gender No main effect for SES (i.e., insurance type)	Parents' and females' knowledge of safe sleep higher than that of expectant parents and males, respectively	Hypothesis 4 not supported, because no main effect for insurance type
Tummy-Time Items			
Multiple regression	(Same results as in safe-sleep regression, above) Main effect for parent type and gender No main effect for SES (i.e., insurance type)	Parents' and females' knowledge of tummy time higher than that of expectant parents and males, respectively	Hypothesis 5 not supported, because no main effect for insurance type

	Additional Exploratory Analyses	
Overall Knowledge		
Multiple regression	Main effect for parent type, gender, and race, even when controlling for education, income, and insurance type	Parents' and females' overall knowledge higher than that of expectant parents and males, respectively; participants who were White had higher incoming knowledge than those who were Black or those from another minority
Sleep Position and Location		
Binary-logistic regressions	Age, race, and education predicted nap position and location; No predictors of position for night; Age predicted night location	Practitioners should place emphasis on providing safe-sleep education to young parents, as well as those from low-education backgrounds Findings were mixed regarding race (minorities more likely to position infants unsafely for naps, but *less* liked to place in an unsafe location for naps).

Appendix I: Demographic Variables Associated with Incoming Safe-Sleep Knowledge ($N = 120$)

Variable	df	F	p	$\eta^2_{partial}$
Step 1 $R^2 = .411$				
Parent type	1	24.93	.000***	.20
Gender	1	17.30	.000***	.15
Marital status	2	1.13	.327	.02
Age	3	.78	.507	.02
Income	3	.58	.629	.02
Insurance type	1	.55	.461	.01
Education	4	.80	.531	.03
Work with children under 3?	1	.04	.843	0
Race	2	1.86	.161	.04

Appendix J: Demographic Variables Associated with Incoming Tummy-Time Knowledge ($N = 120$)

Variable	df	F	P	$\eta^2_{partial}$
Step 1 $R^2 = .491$				
Parent type	1	15.82	.000***	.14
Gender	1	21.54	.000***	.18
Marital status	2	1.82	.167	.04
Age	3	1.10	.355	.03
Income	3	.31	.821	.01
Insurance type	1	2.31	.132	.02
Education	4	.04	.997	0
Work with children under 3?	1	.31	.577	0
Race	2	2.39	.097	.05

Appendix K: Demographic Variables Associated with Overall Incoming Knowledge ($N = 120$)

	Variable	Covariate	df	F	P	$\eta^2_{partial}$
Step 1	$R^2 = .590$					
	Parent type		1	41.14	.000***	.29
	Gender		1	35.05	.000***	.26
	Marital status		2	2.16	.120	.04
	Age		3	.68	.564	.02
	Income		3	.32	.812	.01
	Insurance type		1	1.10	.297	.01
	Education		4	.658	.623	.03
	Work with children under 3?		1	0	.963	0
	Race		2	3.62	.030*	.07
Step 2	$R^2 = .578$					
	Parent type		1	40.63	.000***	.28
	Gender		1	38.99	.000***	.27
	Marital status		2	2.41	.095	.04
	Age		3	.95	.421	.03
	Work with children under 3?		1	.05	.824	0
	Race		2	4.41	.014*	.08
		Income	1	.26	.610	0
		Insurance type	1	1.05	.308	.01
		Education	1	.13	.724	0

Appendix L: Demographic Variables Associated with Position for Naps

Variable	B	SE	Wald	*p*	OR (95% CI)
Parent type *(base = Expectant)*					
Current Parent	.38	.57	.44	.508	1.46 (.48 - 4.41)
Gender *(base = Female)*					
Male	1.03	.83	1.53	.216	2.80 (.55 – 14.26)
Marital status *(base = Married)*					
Single, separated, divorced, or widowed	.94	.97	.94	.333	2.55 (.38 – 16.93)
Living with significant other	.80	.94	.72	.397	2.22 (.35 – 14.05)
Age *(base = 35 to 54)*					
13 to 24	2.99	1.07	7.82	.005***	19.88 (2.45 – 161.46)
25 to 34	1.76	.88	4.06	.044**	5.82 (1.05 – 32.32)
Annual household income *(base = > 90K)*					
< 30K	-2.20	1.43	2.37	.124	.11 (.01 – 1.83)
30 to 60K	-3.54	.99	.13	.720	.70 (.10 – 4.87)
60 to 90K	.06	.83	.01	.939	1.07 (.21 – 5.39)
Insurance type *(base = MA or no insurance)*					
Private insurance	1.45	.96	2.29	.130	4.26 (.65 – 27.81)
Education *(base = Graduate degree)*					
< HS diploma	2.61	1.18	4.88	.027**	13.65 (1.34 – 138.64)
HS diploma or GED	-.55	1.36	.16	.688	5.79 (.04 – 8.33)
Some college or 2-year degree	.71	.93	.58	.448	2.03 (.33 – 12.57)
4-year college graduate	.29	.90	.10	.751	1.33 (.23 – 7.77)
Work with children under 3? *(base = No)*					
Yes	.98	.58	2.91	.088	2.68 (.86 – 8.29)
Race *(base = White or Caucasian)*					
Any minority race	1.29	.64	4.07	.044**	3.65 (1.04 -12.83)

*Note: MA = Medical Assistance. HS = High School. SE = Standard Error. OR = Odds Ratio. 95% CI = Confidence Interval. p < .05 = *; p < .01 = **; p < .001 = ****

Appendix M: Demographic Variables Associated with Position for Sleep at Night

Variable	B	SE	Wald	*p*	OR (95% CI)
Parent type *(base = Expectant)*					
Current Parent	.13	.66	.04	.849	1.13 (.31 – 4.10)
Gender *(base = Female)*					
Male	1.07	.93	1.31	.252	2.91 (.47 – 18.14)
Marital status *(base = Married)*					
Single, separated, divorced, or widowed	.25	1.11	.05	.822	1.28 (.15 – 11.18)
Living with significant other	-.13	1.14	.01	.912	.882 (.09 – 8.30)
Age *(base = 35 to 54)*					
13 to 24	2.19	1.30	2.85	.092	8.89 (.70 – 112.39)
25 to 34	1.72	1.19	2.08	.150	5.57 (.54 – 57.50)
Annual household income *(base = > 90K)*					
< 30K	2.20	1.73	1.62	.203	9.05 (.31 – 267.96)
30 to 60K	1.24	1.15	1.15	.283	3.45 (.36 – 33.17)
60 to 90K	-.99	1.41	.49	.485	.37 (.02 – 5.94)
Insurance type *(base = MA or no insurance)*					
Private insurance	2.14	1.37	2.43	.119	8.48 (.58 – 124.33)
Education *(base = Graduate degree)*					
< HS diploma	1.39	1.26	1.23	.268	4.03 (.34 – 47.45)
HS diploma or GED	-.74	1.56	.23	.634	.48 (.02 – 10.15)
Some college or 2-year degree	1.15	1.09	1.12	.290	3.15 (.38 – 26.43)
4-year college graduate	.94	1.17	.64	.423	2.56 (.26 – 25.51)
Work with children under 3? *(base = No)*					
Yes	.94	.66	2.50	.152	2.56 (.71 – 9.30)
Race *(base = White or Caucasian)*					
Any minority race	0	.77	0	.996	1.00 (.22 – 4.56)

Note: MA = Medical Assistance. HS = High School. SE = Standard Error. OR = Odds Ratio. 95% CI = Confidence Interval.
*$p < .05$ = *; $p < .01$ = **; $p < .001$ = ****

Appendix N: Demographic Variables Associated with Location for Naps

Variable	B	SE	Wald	*p*	OR (95% CI)
Parent type (base = Expectant)					
Current Parent	.30	.49	.37	.543	1.35 (.52 – 3.53)
Gender *(base = Female)*					
Male	.35	.68	.27	.606	1.42 (.38 – 5.37)
Marital status *(base = Married)*					
Single, separated, divorced, or widowed	.23	.95	.06	.811	1.25 (.20 – 8.01)
Living with significant other	.20	.99	.04	.841	1.22 (.18 – 8.51)
Age *(base = 35 to 54)*					
13 to 24	2.32	.85	7.51	.006**	10.17 (1.94 – 53.46)
25 to 34	.63	.60	1.09	.296	1.87 (.58 – 6.06)
Annual household income *(base = > 90K)*					
< 30K	-2.08	1.28	2.64	.104	.12 (.01 – 1.54)
30 to 60K	-.22	.85	.07	.796	.80 (.15 – 4.26)
60 to 90K	.77	.79	.95	.331	2.16 (.46 – 10.23)
Insurance type *(base = MA or no insurance)*					
Private insurance	-8.48	.88	.94	.332	.43 (.08 – 2.38)
Education *(base = < HS diploma or GED)*					
HS diploma or GED	-2.32	.82	8.06	.005**	.10 (.02 – .49)
Some college or 2-year degree	-1.10	.95	1.34	.247	.33 (.05 – 2.14)
4-year college graduate	-.77	1.07	.51	.476	.47 (.06 – 3.81)
Graduate degree	-.98	.97	1.02	.312	.38 (.06 – 2.51)
Work with children under 3? *(base = No)*					
Yes	.37	.49	.57	.450	1.45 (.55 – 3.82)
Race *(base = White or Caucasian)*					
Any minority race	-1.19	.57	4.31	.038*	.31 (.10 - .94)

*Note: We needed to change the Education reference group for this model to "less than a high-school diploma," in contrast to the other models in which the reference group is "graduate degree." MA = Medical Assistance. HS = High School. SE = Standard Error. OR = Odds Ratio. 95% CI = Confidence Interval. p < .05 = *; p < .01 = **; p < .001 = ****

Appendix O: Demographic Variables Associated with Location for Sleep at Night

Variable	B	SE	Wald	*p*	OR (95% CI)
Parent type *(base = Expectant)*					
Current Parent	.12	.58	.04	.836	1.13 (.37 – 3.48)
Gender *(base = Female)*					
Male	.41	.93	.20	.658	1.51 (.25 – 9.22)
Marital status *(base = Married)*					
Single, separated, divorced, or widowed	-1.31	1.07	1.51	.220	.27 (.03 – 2.19)
Living with significant other	-1.99	1.14	3.03	.082	.14 (.02 – 1.29)
Age *(base = 35 to 54)*					
13 to 24	3.64	1.38	6.95	.008**	37.94 (2.54 – 566.76)
25 to 34	2.06	1.18	3.03	.082	7.86 (.77 – 800.03)
Annual household income *(base = > 90K)*					
< 30K	.29	1.43	.04	.840	1.34 (.08 – 21.92)
30 to 60K	1.15	1.07	1.16	.282	3.16 (.39 – 25.75)
60 to 90K	.99	.98	1.03	.310	2.70 (.40 – 18.33)
Insurance type *(base = Medical Assistance*					
Private insurance	-.01	.95	0	.988	.99 (.15 - 6.31)
Education *(base = Graduate degree)*					
< HS diploma	.21	1.20	.03	.855	1.23 (.14 – 11.00)
HS diploma or GED	-.63	1.20	.27	.601	.53 (.05 – 5.61)
Some college or 2-year degree	-.48	.94	.26	.609	.62 (.10 – 3.92)
4-year college graduate	-1.86	1.38	1.81	.179	.16 (.01 – 2.34)
Work with children under 3? *(base = No)*					
Yes	-.23	.60	.15	.700	.80 (.25 – 2.55)
Race *(base = White or Caucasian)*					
Any minority race	.78	.65	1.44	.233	2.17 (.61 – 7.78)

Note: MA = Medical Assistance. HS = High School. SE = Standard Error. OR = Odds Ratio. 95% CI = Confidence Interval.
*$p < .05$ = *; $p < .01$ = **; $p < .001$ = ****

Appendix P: Tummy-Time Session Protocol

Purpose: To assess the effectiveness of experimenter- and parent-led interventions on infant behavior during tummy time.

General Stimulus Conditions: Sessions will take place in an area with minimal distractions and noise within the infants' home (or laboratory setting).

Materials needed: video camera and tripod, white poster board for backdrop, timer, two tummy time mats for each infant (for toy and toy + interaction condition), foam mat (for baseline and interaction conditions), white towel for each infant to cover foam mat.

Setting: Area with minimal distractions and noise within the child' home.

Operational Definitions:

Negative Vocalizations: any whining, crying, coughing, or "fussing."

Head Face Down: infant's head is face down and any part of head (e.g., chin) is in contact with the mat, infant's hands or arms, or parent's chest.

***Head Down- Face Cleared to Side*:** infant's face cleared to one side and cheek is in contact with mat, baby's forearms, or parent's chest.

Head Up- Forward Facing: infant has head lifted up off mat or parent's chest (no part of face/head is touching the mat, infant's forearms or hands, or parent's chest) and *infant is facing in a forward direction*.

Head Up- Face Turned to Side: infant has head lifted up off mat or parent's chest (no part of face/head is touching the mat, infant's forearms or hands, or parent's chest), and *face is turned to the side*.

Chest Up: infant has head is up AND any part of chest is raised off of mat or parent's chest; angle of elbows is less than 90°.

Forearm Support: infant has head and chest up and infant props himself up on forearms, forearms and upper arms are not touching one another (forearms can touch each other), infant is not leaning chest on forearms; angle of elbows is 90° or greater.

Hand Support*:* infant props himself/herself up one or BOTH of his/her hands.

Sleeping: infant's eyes are closed and he/she is not engaging in any negative vocalizations.

Drowsy: infant's eyes are halfway closed, may or may not be accompanied by yawning or rubbing eyes.

Continuous verbal attention: experimenter or parent is talking to infant or making other vocalizations (e.g., "shhhh").

Physical attention: experimenter or parent is stroking the infant's back, arms, head, etc. (e.g., to console infant), tapping infant (e.g., to gain attention), or kissing baby (i.e., relevant to parents only).

Head cleared: The experimenter clears the infant's head to the side (occurs only if the infant has kept head face down for 10 s).

Reposition: Experimenter or parent repositions the infant (e.g., following rolling).

Roll**:** The infant rolls from prone to his/her side or to supine.

General Procedures:

Pre-Session:

1. Place padded foam mat on floor with infant's personal white towel on top of the mat.

2. Five min prior to the start of the session, start video recording either the experimenter or the infant's parent (with parent permission) interacting with the infant. If the parent is delivering attention, the experimenter will tell him/her to interact with their baby continuously in a manner that he/she normally would. To ensure that the parent also provides physical contact and to allow the infant a break from being on his/her tummy, the experimenter will also ask parents that he/she not put the infant down (e.g., on floor, in swing) or place the infant in the prone position prior to the start of session.
3. Ensure that at least 15 min have passed since the infant's last feed and there are more than 30 min until the next feed (if infant has scheduled feeds). If scheduled to eat in next half hour, delay start of session until after the infant has eaten and 15 min have passed.
4. Check diaper if there are visual, olfactory, or auditory signs of a dirty diaper or if infant is engaging in negative vocalizations. If no such signs or negative vocalizations, do not check diaper. If break is following a session and the infant engaged in negative vocalizations in that session, check diaper immediately after session. Record in log if diaper was wet or dirty.
5. Ensure that the infant is alert for at least 1 min prior to the start of the session. The infant will be considered alert if he/she has wide, open eyes, and does not flail his/her limbs, engage in negative vocalizations, or yawn, within the 1 min prior to the start of session.
    a. If after 5 min the infant is engaging in negative vocalizations, prolong the break until 1-min passes without negative vocalizations.

b. Do not initiate or continue sessions for that day if more than 15 min have passed and infant has not achieved 1 min without negative vocalizations.
c. If the infant is engaging in negative vocalizations, a pacifier or toys may be offered during the break to facilitate calmness, but the infant must be without the pacifier (and not engaging in negative vocalizations) for at least 1 min prior to the start of session.

6. If parent does not wish to interact with the infant during session breaks, the experimenter will hold infant while she is seated with the infant on her lap face-to-face, and provide 5-min of high-quality attention to the infant. High-quality attention during this time will consist of making eye contact with infant, talking in an animated voice to the infant, offering gentle vestibular stimulation as needed (e.g., side to side to facilitate alertness, or up and down to facilitate calmness), bringing arms to midline as needed, or "shh"ing (if infant is engaging in negative vocalizations).

Upon Starting Session:

1. Place the participant in the center of the padded mat (either on top of white towel, tummy time mat, or parent's chest, depending on the condition).
2. Place both of the infants' hands and forearms in contact with the floor under the infant's upper torso (i.e., slightly under and to the right of the infant's sternum), and say, "tummy time [participant's name]."

During Session:

1. Follow condition-specific procedures below.
2. Intervene in session if:

a. Infant is head down for 10 s → clear face to side after 10 s.

b. Infant rolls → place back on tummy.

c. Infant pulls self off of mat → position back in the middle of the mat.

After Terminating Session:

1. Pick up infant and provide 5-min of high-quality attention (or have parent interact with infant, if he/she prefers). Check all relevant items under "Pre-Session."

Condition-Specific Procedures:

Baseline:

1. Experimenter will place infant in front of white backdrop, on foam mat with the infant's white towel on top of the mat.
2. The experimenter and any observers will not provide any items, attention, or any other stimulation.
3. The primary experimenter and observers will remain out of view (on other side of board, by camera) but within arm's reach of the participant if any unsafe circumstances may arise
4. Baseline sessions must be split across at least two days (e.g., two sessions on Day 1, and one session on Day 2).
5. After conducting three sessions, experimenter will review the data and will follow table below to determine whether or not to proceed to intervention sessions:

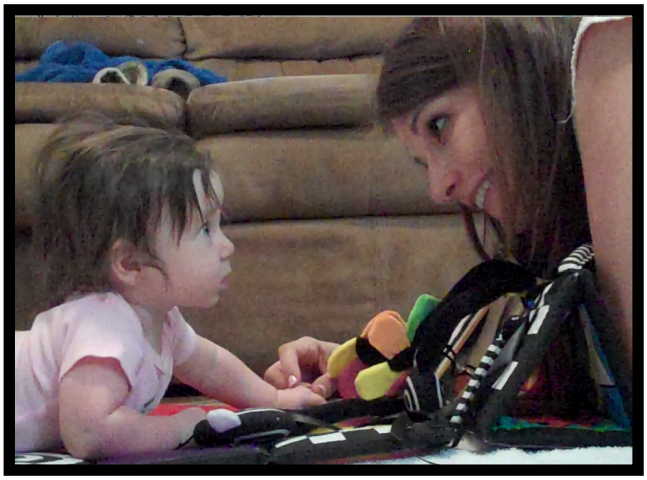
Toy:

1. Condition will be identical to baseline, except the experimenter will place the infant on the tummy-time mat and will place an additional toy (additional mat folded into triangle) 20 to 25 cm front of infant's face.

Adult Interaction:

1. The experimenter will place infant on the same plain mat that was used during the baseline sessions, with the infant's white towel on top of the mat.
2. The experimenter will interact with the infant by providing continuous verbal attention; such attention may consist of responding to infant actions (e.g., "Wow! You are lifting your head so high!"), or providing soothing or encouraging statements (e.g., "It's okay [baby's name]. You can do it!"). Physical attention only provided to gain attention or soothe infant. See below for further details.
3. Experimenter will begin each session no less than 15 cm above the level of the infant's eyes.

Toy + Adult Interaction:



1. The toy plus adult interaction condition will be conducted as described above for both the toy and adult interaction conditions. That is, both interventions will occur concurrently.

Delivery of Adult Interaction in the Experimenter-Led Condition:

1. The experimenter will position herself such that her face is approximately 30 cm in front of the infant's head. The experimenter will talk to the infant using an animated voice to encourage the infant to look forward and up by discussing facial features (e.g., "You have big blue eyes. Let me see your eyes. Look up here. You can do it! Lift your head up, up, up!" "You have a cute nose. Let me see your nose…")[37]
2. If the infant lifts head up, the experimenter will encourage the infant to lift chest up by continuing to discuss facial features as noted above and encouraging the infant to lift chest up (e.g., "Good job lifting your head up! Can you lift your chest up?! You can do it! Lift your chest up, up, up!")
3. If the infant lifts head and chest up, the experimenter will encourage forearm support by continuing to discuss facial features as noted above and encouraging

[37] If the baby is face down and not making any attempt to clear, the examiner will clear the face at 10 s, as noted previously.

the infant to push up on forearms (e.g., “You are such a big boy/girl! Push up on your arms! You can do it! Push up, up, up!”)

4. If the infant gets up on forearms, the experimenter will encourage hand support by continuing to discuss facial features as noted above and encouraging the infant to push up on hands (e.g., “You are so strong [infant’s name]! Can you push up on your hands?! You can do it! Push up, up, up!”)
5. If the infant begins to fuss or cry, the experimenter will use a soothing voice to reassure the infant (e.g., “It’s okay, you can do it, keep trying”), while stroking infant. If crying lasts 2-consecutive min, the experimenter will terminate the session.
6. If the infant becomes drowsy, the experimenter will alternate saying, “[Infant’s name], don’t fall asleep. The sun is out not the moon.” and making novel playful sounds (e.g., clucking, making raspberries) while patting infant’s hand. If the infant falls asleep for 2-consecutive min, the experimenter will terminate the session.

Parent-Led Intervention (Interaction + Toy + Incline Position):

1. Prior to the start of this condition, the experimenter will:
    a. Ask the parent to identify a toy that his/her infant seems to engage with the most. This toy will be

used in all of the parent-led intervention sessions.

b. The experimenter will instruct the parent to interact with his/her infant continuously throughout the session in a manner that he/she normally would, while showing the infant the toy.

2. Upon starting the session, the parent will be seated on a couch, at approximately a 30° angle, with the infant's chest to the parent's chest.
3. The parent will deliver attention continuously throughout the session, while showing the infant the toy, positioned above the parent's left or right shoulder.
4. Should the parent stop delivering attention for more than 5 s, the experimenter will ask that the parent deliver attention.

Session Termination Criteria:

The experimenter will terminate the session and consider it a "failed session" if[38]:

1. Infant has a noticeably dirty diaper in the middle of the session.
2. The infant vomits or has spit up greater than 1 tablespoon.
3. The infant falls asleep for 2-consecutive min[39].

The experimenter will terminate the session but *not* consider it a "failed session" if:

1. If the infant engages in 2-*consecutive* min of crying[40].

[38] The occurrence of #1-3 will result in the experimenter discarding the data for that session.
[39] The data will be included and the session duration will be adjusted for the time that the infant was awake.
[40] These data will be included.

Appendix Q: Experiment 2 Agreement Scores

Participant	% of Sessions with IOA	Negative Vocs	Overall Head Elevation	Level of Head Elevation	Parent and Experimenter Interaction Conditions		Baseline and Toy Conditions	
					Verbal Attention	Physical Attention	Verbal Attention	Physical Attention
Marie	61.90%	92.88%	96.87%	91.89%	96.11%	97.78%	100%	100%
Therese	68.18%	97.82%	97.68%	94.86%	100%	94.07%	100%	100%
Sean	50%	97.37%	100%	96.14%	98.46%	93.70%	100%	100%
Amanda	46%	92.58%	96.91%	92.16%	91.67%	94.04%	100%	100%
Jean	100%	96.50%	97.85%	93.75%	98.52%	92.23%	100%	100%
Edward	68.42%	93.45%	94.58%	90.41%	100%	87.89%	100%	100%
Charles	65%	92.76%	96.92%	90.47%	90%	95%	100%	100%
MEAN	65.64%	94.77%	97.26%	92.81%	96.39%	93.53%	100%	100%

Appendix R: Interventions for Tummy Time Social-Validity Questionnaire

(Administered using SurveyMonkey® online survey)

1. Prior to the start of the study when my baby cried during tummy time, this was emotionally difficult for me.
   Strongly Agree Agree Neutral Disagree Strongly Disagree

2. Prior to the start of the study, my baby's crying made me reluctant to conduct tummy time.
   Strongly Agree Agree Neutral Disagree Strongly Disagree

3. Prior to the start of the study, when my baby cried during tummy time, I would pick him/her up shortly after he/she started crying (i.e., within 30 seconds of crying).
   Always Almost Always About Half of the Time Sometimes Never

4. I was satisfied with how the sessions *on the floor (e.g., with tummy time mat, interaction with experimenter)* helped my baby *cry less*.
   Strongly Agree Agree Neutral Disagree Strongly Disagree

5. I was satisfied with how the sessions *on the floor (e.g., with tummy time mat, interaction with experimenter)* helped my baby *lift his/her head*.
   Strongly Agree Agree Neutral Disagree Strongly Disagree

6. I was satisfied with how the sessions *on my chest while I interacted with my baby* helped my baby *cry less*.
   Strongly Agree Agree Neutral Disagree Strongly Disagree

7. I was satisfied with how the sessions *on my chest while I interacted with my baby* helped my baby *lift his/her head*.
   Strongly Agree Agree Neutral Disagree Strongly Disagree

8. Following the completion of the study, I was more likely to conduct tummy time with my baby than I was prior to the start of the study:
   Strongly Agree Agree Neutral Disagree Strongly Disagree

9. Following the completion of the study, the type of tummy time activity I implemented with my baby the most was:
   a. Putting baby on tummy time mat or with toys to play by him/herself
   b. Putting baby on tummy time mat or with toys while I interacted with him/her
   c. Putting baby on floor without toys while I interacted with him/her
   d. Putting baby on my chest while I interacted with him/her
   e. Putting baby on my chest while I showed him/her toys and interacted with him/her
   f. I did not conduct tummy time with my baby
   g. Other type of tummy time activity used:
      _____

10. Why did you choose the activity selected in #9? (If you selected "f," please explain why you did not conduct tummy time.)

_____
_____
_____
_____
_____

Please answer #11 and #12 if you conducted tummy time following the completion of the study:

11. In the month following completion of the study, when I did tummy time with my baby she/he cried on his/her tummy:
    a. Not at all
    b. Some of the time
    c. About half of the time
    d. Most of time
    e. All of time
    f. I'm not sure or can't remember

12. In the month following completion of the study, when I did tummy time with my baby he/she lifted his/her head:
    a. Not at all
    b. Some of the time
    c. About half of the time
    d. Most of time
    e. All of time
    f. I'm not sure or can't remember

Please use the space below to include any other feedback you have about the study or your baby's behavior during tummy time.

_____
_____
_____
_____
_____
_____
_____

If you would like to receive a $10 gift card to Target, please enter you email address to receive the gift card electronically: _____

Thank you for your participation!

Appendix S: Mother's Descriptive Feedback about the Experiment and Their Practice of Tummy Time

Please use the space below to include any other feedback you may have about the study or your baby's behavior during tummy time: ($N = 4$)
Response
Therese's mother: "It was great!"
Sean's mother: "I enjoyed the study despite [participant's real name]'s reluctance to participate. I would contend, however, that one reason [participant's real name]'s neck muscles developed on time was due to baby wearing which was recently found to build the same muscles instead of tummy time which I didn't subject him to as often as is recommended. I understand the value of tummy time but felt it was too stressful for him (and me) and was not worth the unhappiness it produced. For future children I will continue to offer tummy time, but limit it greatly for those who fervently dislike it as much as [participant's real name]."
Charles' mother: "Before my son participated in the study, I was incredibly reluctant to put him down for tummy time due to the frequency of his crying. I also felt less confident putting him down for tummy time and often felt nervous about letting him cry. The woman who conducted the study, Amber, made me feel relaxed and at ease while conducting tummy time with my son. Amber showed me a variety of ways to engage my son in tummy time and helped me build confidence as a mother to allow my son to explore, play and practice tummy time on his own. I found that halfway through the study, I began placing him on his tummy for tummy time at least twice a day and noticed his growing confidence as well with his abilities as he grew stronger through increased tummy time. I don't think I would have been as eager to use tummy time without Amber's patience and assistance in the process. I was happy to learn new skills through the study and am certain that my son's development has improved as a result of his participation."
Edward's mother: "I am so thrilled that I was a participant in this study! Before the study, I was putting my baby on his tummy and when he cried, I would quickly pick him up or put him on his back. The study helped me work through the emotional reaction to my baby's crying and ultimately helped him tolerate his tummy better. My child has torticollis and the tummy time study truly improved his mobility. And I gained more confidence in his ability to tolerate his tummy better. Thank you!"

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