

Moving into tummy time, together: Touch and transitions aid parent confidence and infant development

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ABSTRACT

“Back to sleep” messages can reduce prone practice for infants, with potential for motor delay and cranial deformation. Despite recommendations for “tummy time,” young infants fuss in prone, and parents report uncertainty about how to help infants tolerate prone positioning. We hypothesized that a ChildSpace Method lesson, teaching proprioceptive touch and transitions to prone, would facilitate prone tolerance, parent behavioral support, and parent self-efficacy. This randomized study recruited parents ($N = 37$) of 2- to 5-month-old infants. On two visits, parents answered questions about infant behavior and parent experience, and played with their infant. Lesson group parents had the lesson following the first free play. One week later, lesson parents reported that infants tolerated more prone time and that parents showed more supportive behaviors in bringing infant to prone, as compared to waiting parents. Lesson parents’ efficacy, and infant behavior during play, trended in the hypothesized direction. The study demonstrated how a lesson in preparatory touch, and gradual transitions, promoted infant prone tolerance and also parent support of rolling, side-lying, and prone positioning. The lesson could be incorporated in parent education and early pediatric visits, helping infants and parents negotiate the prone challenge and setting the stage for further parent support of infant development.

KEYWORDS

coregulation, parent confidence, prone position, proprioceptive touch, tummy time

It is now common practice for medical and social service providers to ask parents to place their young infants on their back for sleep, a result of the extensive “Back to Sleep” campaign aimed at preventing infant deaths from asphyxiation, entrapment, and sudden infant death syndrome (American Academy of Pediatrics Task Force on Positioning and SIDS, 1992). An unintended consequence of this practice is that many infants experience less positional variety, such as lying on their bellies. Pediatricians follow up “back to sleep” (or “safe to sleep”) recommendations with requests to place infants in “tummy time” during the day. Parents comply, but find that their infants often protest the position, and parents report frustration at not knowing how to help their infants tolerate time on their belly. Limited prone experience may lead to achieving milestones at later ages (Dudek-Shriber &

Zelazny, 2007) and has been considered contributory to developing asymmetries such as flattened and protruding skulls, ear displacement, and facial deformation (Mawji, Vollman, Hatfield, McNeil, & Sauve, 2013). For example, 46.6% of Mawji, Vollman, Hatfield, McNeil, and Sauve's (2013) young infant sample showed some degree of plagiocephaly. Deformations can become permanent if not treated early, and treatment (e.g., with helmets) can be costly, lengthy, and inconvenient. These cranial asymmetries alone justify consideration of methods to help parents and infants figure out infant ease in prone.

In addition, supporting positional and movement development will contribute to locomotor, reaching and manipulatory, spatial, cognitive, emotional, and social developments (e.g., Bertenthal & von Hofsten, 1998; Campos et al., 2000; Harbourne & Kamm, 2015; Lee & Galloway, 2012; Lobo &

Galloway, 2012; Soska & Adolph, 2014; Thelen & Spencer, 1998; Woods & Wilcox, 2013). There are numerous perceptual and movement discoveries made possible specifically by coming into prone positions, including lifting and stabilizing the head, weight-shifting across the shoulder and pelvic girdles, and other actions that will lead eventually to independent sitting, crawling, and object manipulation.

Furthermore, when parents know they should position their baby on the belly but do not know how to accomplish this positively, they feel less competent. A parent's sense of competence, or "self-efficacy," is important because it helps the parent face new challenges that arise frequently throughout development. A more positive sense of parenting competence is associated with more positive emotions, parenting practices, and parent-child relations (e.g., Moran, Polanin, Evanston, Troutman, & Franklin, 2016; Teti & Gelfand, 1991). Bandura (1997) emphasized how success in learning a skill, repeated over multiple successes, leads to greater confidence and sense of competence not merely with that skill but also more generally. Less success diminishes self-efficacy, particularly if failures occur before developing a general sense of efficacy. Early parenthood is thus a salient stage for supporting a sense of efficacy. Providing parents with activities they can use immediately to help their young infant tolerate prone positions may give an instant boost to their sense of parenting efficacy.

For the current study, we constructed a lesson rooted in the idea of coregulation between parent and infant, "the dynamic balancing act by which a smooth social performance is created out of the continuous mutual adjustments of action between partners" (Fogel, 1993, p. 19). The movement lesson used here is based in Chava Shelhav's (2017) ChildSpace education method that shows parents how to notice more of what their baby is doing, guide their baby's attention and activity toward healthy development, and find pleasure in their relationship with the baby. The method teaches parents to use touch to connect with the baby, sense themselves as they sense their baby, and help the baby find new movement possibilities, including positions, transitions between positions, self-produced locomotion, manipulation, and oral activity. ChildSpace work is deliberately multimodal and contingent: Touch is combined with gaze and vocalizing not only in face-to-face play but also as the parent narrates many of the movements (e.g., "I'm bending your leg"). Infants are born with a number of perceptual-action coordinations that help bootstrap their attention and learning (e.g., hear-look, grasp-mouth, grasp-look), and multimodal experience is what the infant's nervous system is expecting (Sours et al., 2017). When the parent provides a contingent, multimodal scaffold for infant movement, it is easier for the infant to notice patterns, anticipate what is next, and eventually initiate new acts (e.g., Williams & Corbetta, 2016). An event's intersensory redundancy facilitates the infant's understanding and development

because it stimulates time-locked, overlapping neurological mappings that jointly specify what is happening, often better than would unimodal sensory input (Bahrick, Lickliter, & Flom, 2004; Thelen & Smith, 1996). ChildSpace activity is not merely presented as a muscular pattern to practice but rather as a functional, whole-body movement that has purpose and meaning for the infant (e.g., rolling in a way that the infant can take over, and often combined with additional reason for rolling, such as seeing the parent's face to the side or to reach a toy).

This study's specific lesson included strategies for interacting face-to-face, sensing the baby's ease, and bringing the baby from his or her back gently and gradually onto the tummy, thus providing intermediate steps that promote prone acceptance (rather than just placing baby directly on the tummy with none of the transition experience). We predicted that a single movement lesson, including several simple procedures parents initiated with their young infants, would help the infants tolerate the prone position, expand the parent's repertoire of supportive behaviors with the infant, and provide the parents with a greater sense of efficacy.

1 | METHOD

1.1 | Participants

All procedures were approved by the first author's Institutional Review Board. Parents of 2- to 5-month-olds were recruited through local parenting social media sites, with the notice indicating an opportunity to have a free infant movement lesson as part of a research study. Forty-two parent-infant pairs participated in the first of two sessions (for participant flow through the study, see Figure 1). At the time of the first session, the infants ranged in age from 7 to 24 weeks ($Mdn = 12$ weeks; gestational age at birth range = 36–42 weeks, $Mdn = 40$ weeks; the returning group had the same Mdn and range). Assignment to group was randomized using a random number generator.

1.2 | Materials

A parent questionnaire was constructed to address the content of the ChildSpace Method and this particular lesson. An original questionnaire was constructed rather than using an existing questionnaire because existing questionnaires address issues of attention and efficacy deemed outside the scope of this method. For example, one common scale asks parents how effective they are at getting the attention of the baby, getting the baby to understand the parent's wishes, and getting the baby to show off for visitors (Teti & Gelfand, 1991). In contrast, the current method invites parents to join with the infant's attention (rather than drawing it to the parent's

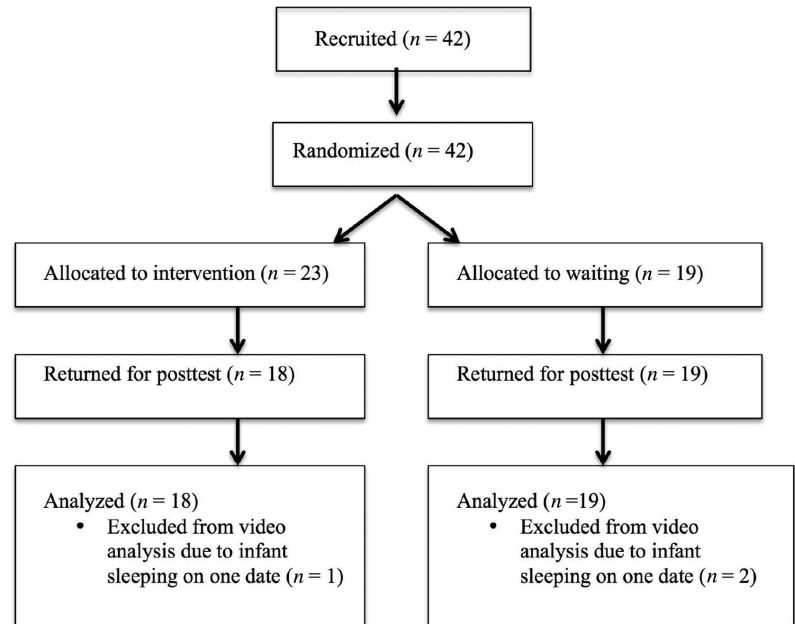


FIGURE 1 Participant flow chart following CONSORT guidelines

agenda), and help the infant find comfort in a variety of positions that the infant can progressively take over him- or herself. The questionnaire includes questions about how long the infant tolerated tummy time per day in the past week; how often parent played with infant on the floor; five questions about the infant's comfort, pleasure, and activity (e.g., "My baby is not comfortable lying on his/her side"), and 11 questions about the parent's sense of their own knowledge, pleasure, and effectiveness (e.g., "I know how to help my baby move into different positions;" for these questions, see the Appendix); and how often the infant turned to sounds (This was a control question not expected to show a lesson effect.) The researchers deemed that a question unrelated to the lesson content would offer an assessment of expectation effects for the lesson group. If there was no group difference in answer to the control question across the two visits (i.e., no statistical interaction), the researchers could be more confident that an interaction of group with test date on target questions was not due merely to expectation for any kind of change for the lesson group. Just as the main survey questions, and the free-play behaviors, were intended to provide information about possible convergent validity, the "control question" was intended to provide a small indication of discriminant validity (Campbell & Fiske, 1959).

During the free-play sessions, several age-appropriate toys were available for parents to use. During the lesson, the teacher used a doll to demonstrate techniques. For video-recording, a digital camcorder was mounted on a tripod in the corner of the room.

The lesson was scripted to include a sequence of steps for the parent to engage the infant's attention, help the infant sense him- or herself, and guide the infant gently in movement. Steps (in the lesson and the handout) included face-to-face

interaction, tapping and squeezing arms and legs, bringing a knee toward the belly, bringing knee over to assist side-lying and eventually coming to prone, stroking alongside the spine in prone, and bringing the knee back through the same arc to allow the infant to feel the return to supine. These steps were repeated on the other side as well, and all steps were contingent on the infant accepting each step. Parents whose infants slept through the lesson were offered the opportunity to do the actions with a doll. The sequence of movements for bringing each baby to his or her side, and then at his or her own pace to prone, provided the parent and infant with a more organic and (eventually) infant-initiated transition to tummy time (i.e., the infant could take over the actions), compared with the typical approach of simply placing the infant directly on his tummy. The lesson script also formed the core of a reminder handout that the teacher distributed following the lesson.

1.3 | Procedure

Sessions were held in a movement studio equipped with mats for sitting on the floor. Each session included between 2 and 5 parent–infant pairs. The parent filled in the questionnaire. Parents and infants then engaged in free play for at least 6 min (5 min of which would be coded for behaviors). This was enough time to see a range of behavior without seeming to be artificial or onerous; other researchers assessing parent free play with young infants have used as few as 3 min or as much as 10 to 30 min (e.g., Bornstein et al., 2010; Feldman, Singer, & Zagoory, 2010). The researcher invited parents to play with their infant as they would at home and to comfort them as needed throughout the session. A few developmentally appropriate toys were provided for any parent who might wish to use them. Approximately 3 min into the free play, the researcher

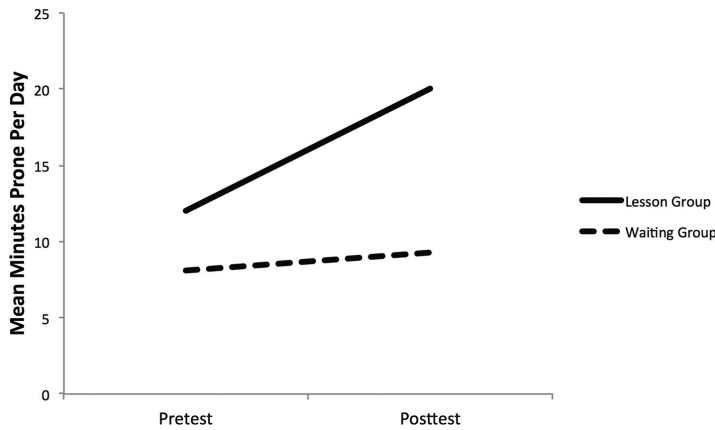


FIGURE 2 Reported tummy time per day in past week, by group and week

asked the parents to bring the infants onto their tummies if they were not already there.

Following the free play, parents were informed of their (randomized) group assignment. Those in the lesson group immediately proceeded to have the lesson, then returned the following week to repeat the questionnaire and free-play procedures. Those in the waiting group returned the following week for the questionnaire and free-play procedures, followed by the lesson.

Coders identified the time to start coding free-play behavior 3 min prior to, through 2 min following, the time that the researcher asked to bring the infant onto the tummy. Video was coded for bouts of 13 targeted parent behaviors (e.g., preparatory proprioceptive touch, bringing knees to belly, stroking along spine, etc.), three alternate parent behaviors (moving the baby in ways inconsistent with targeted behaviors), and six infant behaviors (e.g., turning on own to belly, lifting head on belly, pushing up on hands, etc.). On a subsample drawn from the full range of test dates and parent groups, agreement between coders was 100% on the exact bout count for all behaviors except for infant head turns, where it was 100% within ± 1 bout.

1.4 | Design and statistical analyses

In this randomized, waiting group control design, an analysis of variance (ANOVA) with group (waiting, lesson) as the between-participants factor and week (first, second) as the within-participants factor was conducted on each of the outcome variables: time on tummy, floor play time, infant survey questions, parent survey questions, infant target behaviors, infant behavior variety, parent target behaviors, parent target behavior variety, parent alternate behaviors, and turn to sounds. We predicted that the lesson group would show more positive survey responses, targeted activities, and fewer alternate activities, at the Week 2 posttest, relative to the waiting group. This outcome would be seen in a significant Group \times Week interaction in the ANOVAs (described next).

2 | RESULTS

2.1 | Time (min) per day infant tolerated being on tummy in past week

The ANOVA yielded a significant interaction of group with week, indicating that lesson infants showed a greater increase from the first ($M = 12$ min), 95% CI [6.8, 17.2], to the second ($M = 20$ min), 95% CI [12.2, 27.8], visit in tolerated tummy time as compared with the waiting group, $F(1, 32) = 5.98$, $P = .02$. In addition, the lesson group reported babies tolerating slightly more tummy time from the outset, main effect of group: $F(1, 32) = 4.37$, $P = .04$, and there was an increase from pretest to posttest overall, main effect of week: $F(1, 32) = 11$, $P = .002$, but as can be seen in Figure 2, these main effects are qualified by the interaction in which most of the shift was in the lesson group at the posttest.

2.2 | Floor play in past week

There were no effects of factors on the number of times that parents reported playing with their infant on the floor. Parents reported an average of 14.3 times per week, or about twice per day, range = 2–50 times per week.

2.3 | Turn to sounds other than parent voice

Answers to this control question were not expected to be affected by the lesson, and they were not. There was no effect of group or interaction of group with week. On a scale from 1 (*rarely*) to 4 (*frequently*), there was a small increase from the first ($M = 2.9$), 95% CI [2.6, 3.2], to second ($M = 3.2$), 95% CI [2.9, 3.5], week for the whole sample, $F(1, 34) = 4.55$, $P = .04$. This supports the possibility that significant lesson group changes in relevant variables (e.g., time on tummy, parent behavior during free play) were likely due to the lesson and not merely to expectations for change generally (i.e., this supports discriminative validity).

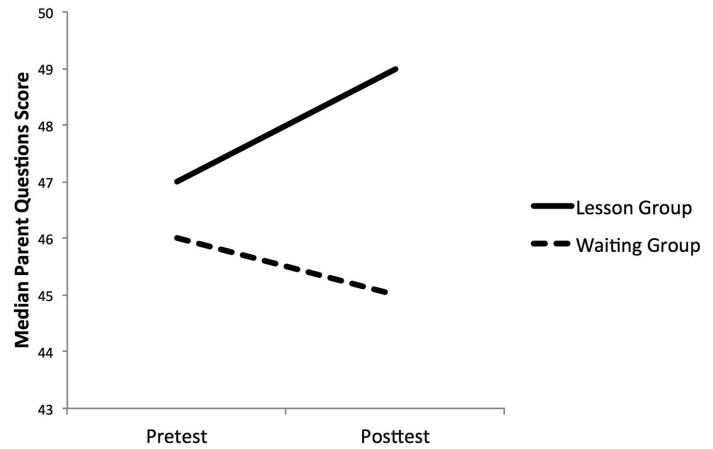


FIGURE 3 Parent questions score, by group and week

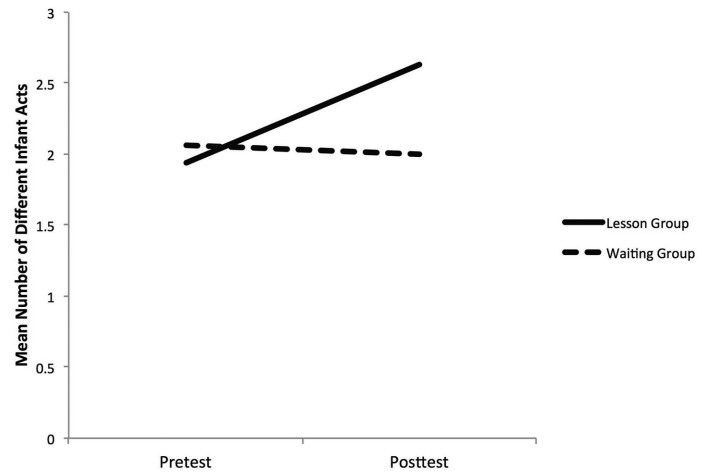


FIGURE 4 Infant behavior variety during free play, by group and week

2.4 | Infant survey questions

The five infant questions yielded a combined score that could range from 5 to 25, with higher scores indicating that the parent reported the baby as acting more comfortable and attentive, and showing more enjoyment of activity. Because there are no psychometrics for the survey created for this study, a nonparametric Mann–Whitney test was conducted on change scores (posttest minus pretest). For the infant-focused questions, a Mann–Whitney test showed no difference in change scores between the groups (waiting group *Mdn* change score = 0; lesson group *Mdn* change score = 1). The sample's pretest and posttest *Mdn* scores were both 20.

2.5 | Parent survey questions

The 11 parent questions yielded a combined score that could range from 11 to 55, with higher values indicating more reported knowledge and enjoyment interacting with the baby. For the parent-focused questions, the lesson group *Mdn* change of 3 points was larger than the waiting group *Mdn* change of 2 points, but this difference was not enough to reach significance, Mann–Whitney test, $P = .08$ (for group medians at pretest and posttest, see Figure 3).

2.6 | Infant target behaviors score

There were no main effects or interaction for bouts of free-play infant target behaviors. Infants showed a mean of 5.2, 95% CI [4.1, 6.4] bouts of targeted behaviors in each session.

2.7 | Infant target behavior variety

For the range of targeted behaviors infants showed during free play, the lesson infants' target behavior variety increased, but did not reach significance, $F(1, 31) = 3.19$, $P = .08$ (see Figure 4). There were no main effects.

2.8 | Parent target behaviors score

For parent target behavior bouts, the ANOVA showed a main effect of week, $F(1, 31) = 5.21$, $P = .03$, but the effect is qualified entirely by the interaction term. There was a significant interaction of group with week, $F(1, 31) = 5.08$, $P = .03$, indicating that lesson group parents' behaviors more than doubled on the posttest, relative to the waiting group (see Figure 5). The lesson group's additional behaviors at the second visit spanned all types, but particularly included more tapping the baby's shoulder and shifting the baby's pelvis.

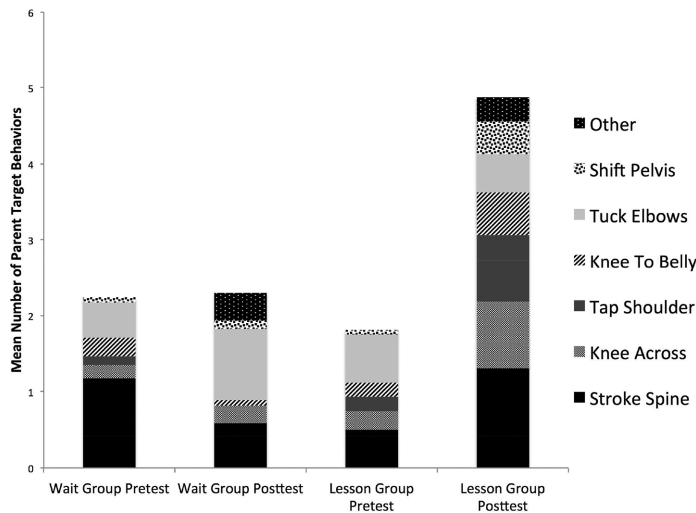


FIGURE 5 Parent target behaviors during free play, by group and week

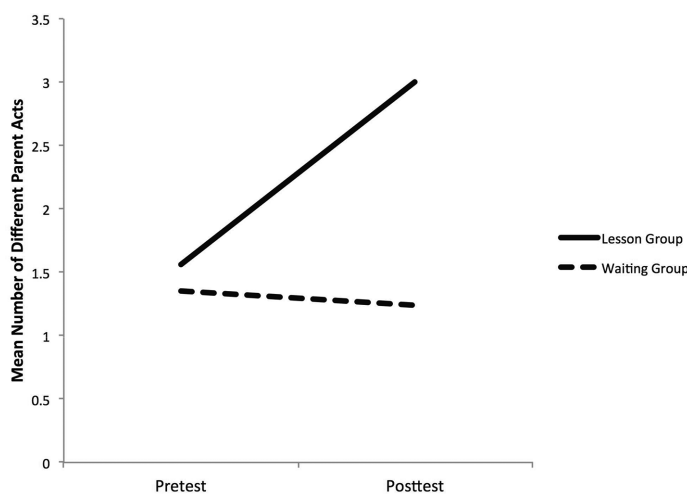


FIGURE 6 Parent behavior variety during free play, by group and week

2.9 | Parent target behavior variety

The ANOVA on the number of different targeted parent behavior categories showed significant main effects of group, $F(1, 31) = 5.08, P = .03$, and week, $F(1, 31) = 5.06, P = .03$, but these are clarified by the significant interaction in the predicted direction, $F(1, 31) = 7.55, P = .009$. Lesson parents used more varying supportive acts on the second visit ($M = 3.0$), 95% CI [2.2, 3.8], as compared with the waiting parents ($M = 1.2$), 95% CI [.5, 1.9] (see Figure 6).

2.10 | Parent alternate behavior score

The parent alternate behavior score consisted of bouts of three alternate parent actions that were not taught, and were not infant-directed ways to bring baby onto his or her side, belly, or back. Most of these bouts were bringing the baby onto the tummy directly, without transitions. The ANOVA showed a main effect of group, $F(1, 32) = 5.52, P = .02$, with the waiting group showing a greater alternate score than did the lesson group; this effect, however, was entirely qualified by the significant interaction term. The significant interaction of

group with week, $F(1, 32) = 13.52, P < .001$, showed that the waiting group's scores increased at the posttest ($M = 1.4$), 95% CI [1.0, 1.8], and the lesson group's scores decreased at the posttest; the lesson group posttest alternate score was noticeably lower than all other scores ($M = .35$), 95% CI [.12, .58] (see Figure 7).

3 | DISCUSSION

Parents who participated in an infant-centered, tummy-time movement lesson reported that their infants spent significantly more time tolerating the prone position in the week following the lesson. In live interaction, lesson parents used more targeted behaviors, more varying behaviors, and fewer inconsistent behaviors with their young infants, as compared with waiting control parents. Also in the predicted direction, just shy of statistical significance, were lesson parents' responses to the parent-directed survey questions, and infant target behavior variety during free play.

These results supported the hypothesis that a single lesson (encouraging coregulation, proprioceptive touch, and

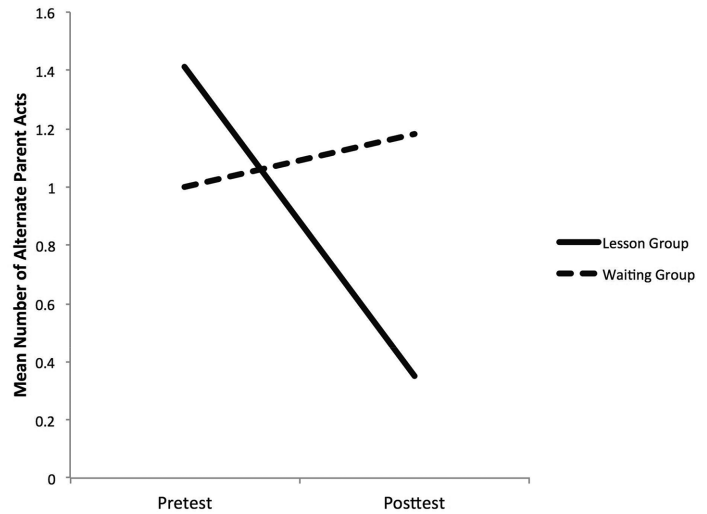


FIGURE 7 Parent alternate behaviors during free play, by group and week

gradual transitions toward side-lying, prone, and return to supine) could promote infant prone tolerance, parent behavioral repertoire, and parent experience. We focused on facilitating tummy time because it is an early milestone that challenges both infant and parent, and because prone tolerance facilitates further developments. Longer times spent in prone predicts milestones beyond just prone, including supine and sitting achievements. Dudek-Shriber and Zelazny (2007) found that 4-month-olds who spent at least 81 min in prone per day showed particularly clear advances in other milestones. Our sample was on average younger and spent less time in prone, but our young infants added an average of 8 min daily tolerating prone positioning over the course of the week following their lesson.

Despite the developmental value recognized for tummy time, parents and providers alike are often uncertain about awake tummy-time recommendations, with some research indicating that few providers even discuss it by 2 months of age (e.g., Koren, Reece, Kahn-D'angelo, & Medeiros, 2010). Furthermore, when a baby will not tolerate more than a short time in prone, without the current kind of support, parents are in a bind about following the pediatrician's advice and ignoring baby's distress, or doing less than a recommended amount of prone time and feeling that they are not meeting their baby's needs, that they are spoiling their baby, dooming them to delays, or judging themselves as bad parents. ChildSpace procedures, however, are designed to alleviate this bind, and could be easily implemented in routine pediatric and parent education sessions. Key to this implementation is the infant-centered preparatory and stepwise transitional qualities of the interactions. ChildSpace procedures differ from protocols specifying what to do to, or with, an infant without tailoring actions to the infant in the moment. Caregivers can place an infant directly in prone, fulfilling the mandate for tummy time, but this does not provide the infant with the organic experience of pressing into the floor, weight shifting,

rolling, side-lying, extension, lifting the head and other components of accomplishing the position, and reversing out of it, in all the movements' rich complexity. Also novel is the invitation for the parent to sense themselves connecting to their infant. The ChildSpace approach promotes a sense of self-efficacy for both infant and parent, and this may be especially important for special needs situations where the parent needs to learn how to read their infant and provide finely adapted experiences. As Thelen and Smith (2006) noted, the parent's "behavior and infant sensory capacities interact to generate the development of more advanced infant behavior. Thus, the patterns of interaction between caregivers and infants are a source of developmental change" (p. 266).

3.1 | Limitations

Given that the lesson group experienced some focus on processes including coming onto the tummy and that the waiting group did not have this same experience until after the second free-play session, there may have been some expectation bias for the lesson group about the focus on tummy time. An alternative design would be to offer the waiting group some standard information about the value of tummy time, but without the distinctive approach that the lesson group experienced. All participants did know from the initial survey that tummy time was of interest (three questions addressed it) and from the free-play session that bringing their infant onto the tummy was of interest. Indeed, the request to bring onto the tummy was the only one posed during free play. The researchers used multiple assessments to evaluate the effects of lesson experience, consisting of self-report as well as direct observation of infant and parent behavior. The researchers did not ask parents to use these methods overtly but rather their behavior showed that they now knew ways to bring their infant to the tummy in ways that made sense to the infant. The joint result of these multiple assessments supports the view that this was an

informative and effective intervention, though an expectation bias may have played some role.

There were three measures that showed no lesson effect: parents' estimated floor play time, the infant survey questions, and the infant target behaviors. Parents clearly understood the point of the lesson to be helping the infant get to the tummy and find greater comfort in prone; the extension of this to promoting more parent–infant floor play time generally was an indirect possibility, and this could emerge from greater overt emphasis and also additional lessons on other ways to engage the infant. Similarly, one lesson may not be enough to yield changes on the infant survey questions or in infant behavior frequency coded during free play. It was reassuring that infant behavioral variety was in the predicted direction. Furthermore, lesson parents typically offered additional positive and detailed comments after the formal assessments (survey and free play) concluded, and it would be useful for future designs to capture more content from these reports. Finally, replication with new samples and teachers will strengthen the argument that these procedures facilitate tummy time.

3.2 | Conclusions

A single ChildSpace Method lesson, showing parents how to use infant-centered proprioceptive touch and movement transitions, helped infants tolerate more time prone, and resulted in parents employing more and varied techniques for bringing infants to side-lie and into tummy time. These simple procedures could be readily included in parent education and pediatric sessions with infants in the first months of life, facilitating further infant development and parent sense of efficacy.

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CONFLICT OF INTEREST

There are no conflicts of interest.

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APPENDIX

This week, how often was your baby turning his/her head toward sounds other than your voice? (answered on a 4-point scale from “rarely” to “frequently”)

Parent Survey Questions (answered on 5-point scale from “strongly disagree” to “strongly agree”):

I can tell when my baby is interested in something.

My baby is not comfortable lying on his/her side.

I enjoy face-to-face time with my baby.

I am not interacting in a way that helps my baby learn.

My baby enjoys my touch.

I am not sure whether I am handling my baby in a way that's comfortable for her/him.

I can tell when my baby needs a break.

I know how to help my baby move into different positions.

My baby responds to my voice.

I don't know how to help my baby feel comfortable on her/his tummy.

My baby does not move a lot.

I enjoy touching my baby.

I feel that my baby and I communicate well.

I don't feel that I interact physically well with my baby.

My baby is comfortable lying on his/her tummy.

I feel I am doing a good job parenting.