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# Changing opportunities for learning in everyday life: Infant body position over the first year

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Developmental theories depend on characterizing the input to potential learning mechanisms—infants' everyday experiences. The current study employed a novel ecological momentary assessment to measure two aspects of the physical context of those experiences: body position and location. Infant body position was selected because it relates to the development of a variety of other skills. Caregivers of 3-, 6-, 9-, and 12-month-olds reported infants' body position—held, supine, reclined, prone, sitting, or upright—in response to text message notifications over a week to capture infants' experiences across the entire range of their daily activities. Findings revealed a tremendous disparity in the distribution of body position experiences over the first year. Younger infants spend more time held, supine, and reclined, whereas older infants spend more time sitting and upright. Body position experiences differed substantially between same-age infants who possess a motor skill (e.g., ability to sit or walk) compared with those who did not, suggesting that developing motor skills change infants' everyday experiences. Finally, the success of the methodology suggests that similar ecological momentary assessments might be used to study a wide range of infants' naturalistic experiences.

The development of new motor skills is theorized to have downstream effects on infants' cognitive and social development (Adolph & Robinson, 2015; Bertenthal, Campos, & Kermoian, 1994; Campos et al., 2000; Gibson, 1988; Libertus & Hauf, 2017). For example, learning to sit is linked with better object perception (Soska, Adolph, & Johnson, 2010) and learning to walk with improved language ability (Walle & Campos, 2014). The theoretical mechanism underlying such effects is that emerging motor skills alter infants' everyday experiences: Changes in how infants interact with the world change opportunities for learning. But despite many such studies relating infants' motor skills to different outcomes, the everyday physical experiences assumed to mediate these relations have received little attention (cf. Karasik, Tamis-LeMonda, Adolph, & Bornstein, 2015; Majnemer & Barr, 2005). Which experiences are most frequent, how do those experiences change, and why do they change? How much more experience do infants who have learned a new skill accrue? Knowing the statistics of infants' everyday experiences is vital for constraining developmental theories and building computational models.

The current study asks how the physical context of infants' everyday experiences—how much time they spend in different body positions—changes over the first year of life and how those changes relate to developing motor skills. The typical approach is to use onset ages of motor skills (e.g., how long has an infant been able to sit) as a proxy for experience (e.g., time accrued in a sitting position) (for a review, see Adolph & Robinson, 2015). However, time since onset of a skill does not reveal how often infants use skills in everyday life (Adolph, Robinson, Young, & Gill-Alvarez, 2008; McCall, 1977). Moreover, measuring only onset ages, a single time point, cannot reveal age-related changes in the frequency of different experiences. For example, direct observations of infant play show that walking infants spend more time in motion, take more steps, and travel greater distances compared with crawling infants, so the accumulation of walking versus crawling experience is dramatically different over the same period of time (Adolph et al., 2012; Adolph & Tamis-LeMonda, 2014). Although observational studies can accurately measure experiences, there are several limitations. When assessments take place in laboratory rather than home settings and focus on playtime contexts only, generalization is restricted (Tamis-LeMonda, Kuchirko, Luo, Escobar, & Bornstein, 2017). Collecting and coding behaviors from video is labor intensive, thus, most observations are rel-

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atively short (an hour or less) and need to be scheduled at times that are convenient to both caregivers and researchers. Ecological validity requires broader, unbiased time sampling to measure physical experiences across an entire day and all of the various activities (Fausey, Jayaraman, & Smith, 2015; Hofferth & Sandberg, 2001) contained therein (e.g., feeding, bathing, errands, etc.).

I addressed these concerns by designing a novel *ecological momentary assessment* (EMA) method to study everyday body position. EMA methodologies assess participant behavior repetitively in daily life, with diverse applications such as studying cigarette cravings during smoking cessation and coping behaviors during illness (Shiffman, Stone, & Hufford, 2008). The strength of EMA is using immediate (momentary) reports rather than retrospective reports because accuracy of retrospective reports suffers from systematic memory biases associated with recall (Bradburn, Rips, & Shevell, 1987). Numerous methodologies fit under the umbrella of EMA. For example, EMA can be event-sampled to narrow responding to particular daily events or time-sampled to assess the overall pattern of experiences across an entire day (Shiffman et al., 2008). Data can also be recorded in different ways, such as paper and pencil surveys or diaries (Stone, Shiffman, Schwartz, Broderick, & Hufford, 2003; Williams, Suls, Alliger, Learner, & Wan, 1991), smartphone or PDA devices (Kimhy et al., 2006), or physiological measurements such as ambulatory blood pressure (Kamarck et al., 2002).

In the current study, caregivers electronically reported infant body position throughout the day (time-sampled) in response to text message notifications on their smartphones. Using EMA to study infant behavior has great potential for testing other aspects of infants' natural experiences; thus, a secondary aim of the study was to determine the feasibility of this method using body position as a test case. In particular, the rate of responses and the lag time of responses was assessed to measure compliance of the respondent as is typical in EMA studies (Scollon, Kim-Prieto, & Diener, 2003; Shiffman et al., 2008).

### Importance of body position

The amount of time infants spend in different positions reflects opportunities to practice and develop motor skills (Adolph et al., 2012; Karasik et al., 2015). For example, an unintended result of the "Back to Sleep" campaign, which promotes supine—rather than prone—sleeping as a preventative measure against SIDS, is that less prone experience delays acquiring prone skills unless caregivers provide infants with additional "Tummy Time" opportunities (Jantz, Blooser, & Fruechting, 1997; Majnemer & Barr, 2005). Furthermore, understanding body position is relevant to infancy researchers more generally because it is theorized to have cascading effects on other areas of development. For example, moment-to-moment body position shapes infants' visual and manual activity. Presumably, these visual and motor experiences lead to downstream effects on perceptual, cognitive, and social development. However, concrete information about the volume of such experiences and how they differ with age and motor skill is lacking.

Body position shapes visual experiences. While prone, 12- to 13-month-old infants' view is dominated by the ground and infants rarely see toys and caregivers' faces (Franchak, Kretch, & Adolph, 2018; Kretch, Franchak, & Adolph, 2014). Face-looking is more frequent when sitting or upright compared to prone but is infrequent overall (across different positions) while playing on the floor (5% of the time). Infants look more often at faces while elevated, such as when sitting at a table or while held off the ground in a forward-facing infant carrier (15-50% of the time) (Franchak, Smith, & Yu, in preparation; Kretch & Adolph, 2015; Yu & Smith, 2013). Thus, infants accrue varying amounts of experiences looking at faces depending on how often they are in different positions at different ages and whether their viewpoint originates from a location on or off the ground. Indeed, naturalistic recordings from head-mounted cameras show that young infants often have faces in view, but the availability of faces declines from birth to 24 months (Fausey, Jayaraman, & Smith, 2016; Jayaraman, Fausey, & Smith, 2015). How this relates to body position is still unknown. Younger infants would see faces more frequently if they spend more time up off the ground held by caregivers or reclined/supine with their heads pointed up towards caregivers. Access to faces may decline if older infants increasingly spend more time on the ground in prone, sitting, and upright positions and are held less often. Characterizing the changing frequencies of body positions and their location (on the ground or off the ground) will provide valuable context for interpreting developmental changes in visual experiences of faces and other developmentally-relevant stimuli.

Manual action is also tied to body position. Real-time observation shows that infants manipulate objects more frequently while sitting compared to while supine or prone (Soska & Adolph, 2014). While prone, infants use both arms to prop themselves up, and while supine, infants struggle to hold their arms up against gravity. In contrast, sitting provides a stable base of support and frees the hands, which facilitates visual, manual, and oral exploration of objects (Bertenthal & von Hofsten, 1998; Rochat & Goubet, 1995; Soska & Adolph, 2014). Consequently, learning to sit is associated with earlier achievements in object perception and cognition (Ross-Sheehy, Perone, Vecera, & Oakes, 2016; Soska et al., 2010). Infants who can sit independently at 5 months spend more time sitting in daily life (Karasik et al., 2015), which presumably allows sitting infants to more often enjoy the real-time benefits of sitting for object exploration. Measuring age-related changes in sitting frequency will provide further context for understanding developmental changes in object exploration.

## Methodological limitations in documenting infants' naturalistic body position

The few previous studies to document infants' naturalistic body position have used two methodologies: Direct observations (in person or video recording) and survey methods (retrospective reports or diaries). Although each method provides valuable data, both methodologies have limitations that are addressed using an EMA methodology. Two naturalistic laboratory observations measured body position during infant play. A longitudinal study found that sitting was most frequent position from 6 months of age (> 50% of the time) until the onset of walking, after which upright positions (standing and walking) became dominant (Thurman & Corbetta, 2017). Similarly, another laboratory observation found that 12-month-old crawling infants spent more time sitting (46%) compared to prone (25%) and upright (29%), whereas 12-month-old walking infants spent more time upright (70%) compared to sitting (25%) and were rarely prone (5%) (Franchak et al., 2018). However, these results only generalize to infants' play time, which accounts for just a portion of the day (Fausey et al., 2015; Tamis-LeMonda et al., 2017); the time spent in different body positions likely varies according to the distribution of daily activities. For example, caregivers rarely held infants during laboratory play sessions, but must hold infants frequently while feeding, bathing, dressing, and comforting them in the home. The focus on spontaneous locomotor play also prohibited caregivers from placing infants in common positioning devices (e.g., car seats, infant carriers, and high chairs) that would restrict body position (Callahan & Sisler, 2007).

A more comprehensive observational study was conducted by Bril and Sabatier (1986), who used paper and pencil recordings to document body position for 2 full days in the lives of 4 Bamabara infants (Mali). The youngest infant (1 month) spent the most time supine (33%) and reclined (39%), whereas the oldest infant (6 months) spent the most time in a sitting position (39%). All infants were frequently held by caregivers. However, the limited age range and small number of participants restrict the generalizability of the data.

Retrospective surveys are less time-consuming and allow researchers to more easily assess body position across an entire day. However, body position and physical experiences in general are difficult to study using retrospective surveys (I ask skeptical readers to recall how long they sat, were upright, and were reclined in the last 24 hours). Although caregivers can easily make binary reports of whether a child did a skill or not each day (Adolph et al., 2008), magnitude estimates of how long infants spent in activities, such as "Tummy Time" or playing on the floor, have low reliability (Hnatiuk, Salmon, Campbell, Ridgers, & Hesketh, 2013). Diary studies that ask caregivers to make periodic records throughout the day are likely to be more accurate because they are based on more recent observations of behavior and restricted to a narrower time window despite relying on recall. Majnemer and Barr (2005) asked caregivers to record the duration of prone, supine, upright, sitting, and held positions in 5-minute intervals every 2-3 hours. Four-month-olds spent most of the time held or in supported sitting (38% and 37% of the waking day). By 6 months, supported sitting was unchanged, but unsupported sitting (11.5%) eroded time spent held by caregivers (28%). These results comprise the most comprehensive accounting of infants' body position to date because they involve full-day recording from a sufficiently large sample. However, two limitations create the need for additional research. First, only two ages were studied (4 and 6 months), so it is unknown how body position changes over infancy as motor skills like sitting, crawling, and walking are acquired. Second, there is potential for bias and inaccuracy in caregiver memories of body position over 2-3 hour periods. Rare events may be more easily forgotten and salient events, such as independent sitting for a new sitter, may be over-represented. Immediate reports would decrease the potential for bias and inaccuracy.

## Current study

Although prior work finds a consistent pattern of results, generalization is limited by restricted activity contexts (Franchak et al., 2018; Thurman & Corbetta, 2017), short observation times (Franchak et al., 2018; Karasik et al., 2015; Thurman & Corbetta, 2017), reliance on retrospective reports (Hnatiuk et al., 2013; Majnemer & Barr, 2005), and narrow age ranges (Bril & Sabatier, 1986; Franchak et al., 2018; Hnatiuk et al., 2013; Karasik et al., 2015; Majnemer & Barr, 2005). Moreover, inconsistent coding schemes used across investigations that tested infants of different ages and in different settings preclude direct comparisons.

These limitations are addressed in the current study by asking caregivers of 3-, 6-, 9-, and 12-month-old infants to periodically provide direct observations of infant body position using an EMA methodology. Samples were distributed across infants' waking day over a 7-day period to better capture infant body position across their daily routines. To avoid reliance on memory, caregivers reported infant body position immediately in response to text messages received on a smartphone in brief, 1-minute surveys. Caregivers were not aware of when notifications would arrive to avoid bias in reporting. A simple body position coding scheme allowed caregivers to accurately categorize held, supine, reclined, prone, sitting, and upright positions (Figure 1). Note, in the context of the current study, the term "prone" will be used to refer to any position with the belly towards the ground, even if the belly is not in contact with the ground. To better understand the changing physical context of infant body position, caregivers also reported infants' location: whether on the floor or up on a raised surface.

The first aim was to characterize age-related changes in body position and location over the first year of life. Measuring the same position categories with the same methodology over the first year will determine the volume of experiences for each position at each age and to verify the age-related changes suggested by past work (decline in held, reclined, and supine positions and increase in prone, sitting, and upright). The current study goes a step further by testing across a wider age range compared to past research and by asking how body position varied according to location. Measuring infants' location—on or off the ground—when in different body positions will help to reveal the changing context of infants' physical experiences and will provide a proxy for understanding age-related changes in experiences relating to body position, such as vision. Past work shows that prone, sitting, and upright positions on the ground provide a poor view of faces compared with sitting or being held up off the ground (Franchak et al., 2018; Kretch & Adolph, 2015; Kretch et al., 2014; Yu & Smith, 2013). An increase in time spent prone, sitting and upright on the floor might account for decreasing availability of faces in view (i.e., Jayaraman et al., 2015).

The second aim was to test how motor skill acquisition alters experiences with different body positions. Caregivers can choose to place infants in any position—no motor skills are needed to lie prone, and caregivers can support infants of any age in a sitting or upright position. However, attaining a motor skill that allows infants to maintain a body position independently should increase the frequency of that position beyond the experience that requires support from caregivers or infant furniture. To test this, caregivers reported the onset of three motor skills: sitting, crawling, and walking. For each skill, three groups were compared: infants who could do a skill (e.g., 6-month-old sitters), infants of the same age who could not (e.g., 6-month-old non-sitters), and younger infants who could not (e.g., 3-month-old non-sitters) to measure the extent to which new motor skills versus age alone alter infants' experiences. Importantly, this tests the key assumption of using onset age as a proxy for experience—that infants who possess a skill experience that skill more than those who do not—but goes further to reveal precisely how much more experience is accrued.

The third aim was to assess the suitability of the new EMA method for studying infants' naturalistic behavior through caregiver report. The goal of sending survey requests via text message over the course of the day was to gather immediate reports on infant behavior over the course of the day rather than using a diary method that asks caregivers to remember the frequency of behaviors over several hours. However, EMA studies that overly burden participants by asking for too many reports can suffer from low compliance or long response lags (Shiffman et al., 2008; Stone et al., 2003). If caregivers failed to notice survey notifications, chose not to (or were unable to) respond in a timely manner, or ignored notifications entirely, the time sampling would be biased and might not represent infants' entire day. EMA studies request participants to complete as many as 20 surveys per day (Kamarck et al., 2002), but caregivers busy with young infants might burdened by too many responses and consequently fail to respond. Past work with mothers of young children found good compliance (85% completion rate) when prompted 8 times per day (Williams et al., 1991); the current study conservatively requested only 5 daily responses. Prior work also indicates that compliance is better when using electronic recording methods rather than paper and pencil methods (Stone et al., 2003), so smartphones were used to notify caregivers and record their responses. A second benefit of electronic recording is that response lags can be objectively measured based on the timestamp of the notification relative to the survey submission, whereas with paper and pencil recordings participants might be tempted to misreport response times to feign compliance (Stone et al., 2003).

## Method

### Participants and design

Infants ($N$ = 95) were recruited in four age groups: 3 ($n$ = 24, 16 female), 6 ($n$ = 25, 11 female), 9 ($n$ = 22, 12 female), and 12 months ($n$ = 23, 15 female). Scheduling ensured that the first day of observation was no earlier than 2 weeks before the target age and the final day of observation was no later than 2 weeks after the target age (e.g., 2.5-3.5 months for 3-month-olds). The mean start ages for each group were: 3 months, $M$ = 2.9 ($SD$ = 0.31); 6 months, $M$ = 5.8 ($SD$ = 0.27); 9 months, $M$ = 8.8 ($SD$ = 0.26); 12 months, $M$ = 11.8 ($SD$ = 0.30). The mean ages at the last observation were: 3 months, $M$ = 3.3 ($SD$ = 0.33); 6 months, $M$ = 6.2 ($SD$ = 0.33); 9 months, $M$ = 9.2 ($SD$ = 0.29); 12 months, $M$ = 12.2 ($SD$ = 0.30). Participants were recruited from across the United States through social media and listserv advertisements and received $25 gift certificates as compensation.

Eighty-one informants provided demographic data (14 declined). Participants were recruited from 20 different US states, with the largest proportion of participants residing in California (23.4%), New Jersey (13.6%), and Indiana (12.3%). Informants were primarily female (93.8%), White (84.0%), and highly educated (37% with Bachelor's degree and 51.9% with graduate or professional degrees). The mean age of informants was $M$ = 31.5 (range = 23.7-38.4). The study consisted of three parts: an introductory phone call, 7 survey days, and an exit phone call. To be eligible to participate, the caregiver needed to be able to schedule 7 survey

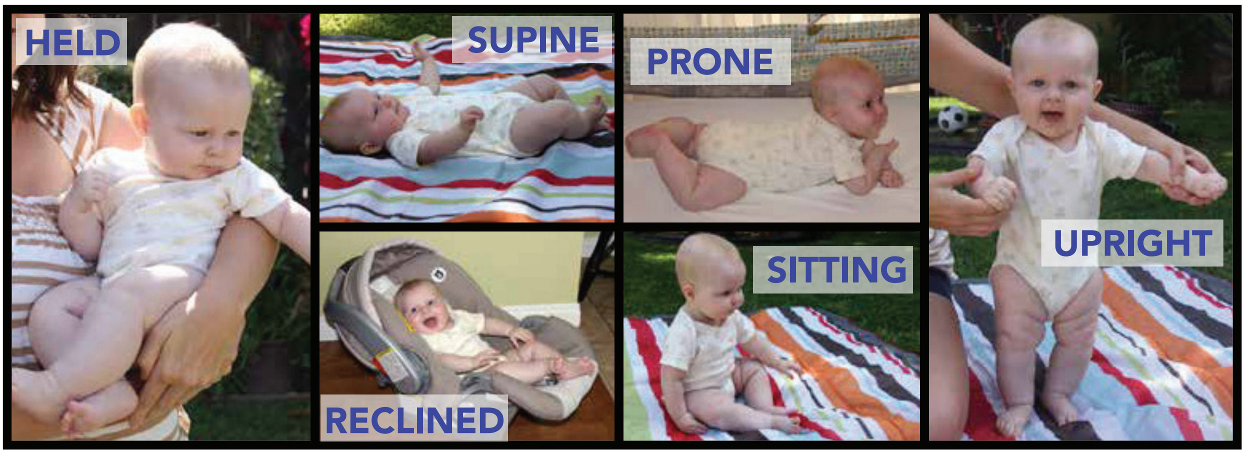


*Figure 1*. Examples of the six body positions studied: Held, supine, reclined, prone, sitting, and standing. This image was included in the survey provided to caregivers to refer to when reporting infant body position.

days within ± 2 weeks of the target age in which he or she would be with the infant for the entire day. Three additional participants were recruited but chose to withdraw after the introductory phone call. The study procedure was approved by the Institutional Review Board of the University of California, Riverside. Caregivers received an electronic consent form and provided verbal consent to participate in the experiment during the introductory phone call.

## Procedure

**Introductory phone call.** At the beginning of the study, the experimenter conducted a 20-minute phone call with the caregiver. Caregivers were provided with an electronic instruction manual (Supplementary Materials) to follow during the phone call. During the call, the experimenter explained the notification procedure and the criteria for each of the body position categories. Representative photographs for each position illustrated different variations. After the training, caregivers were provided with 8 unlabeled photographs to categorize into the 6 positions. All participants completed the training verification with 100% accuracy. Finally, caregivers chose 7 days to participate when they planned to be with their child for the entire day. To accommodate working caregivers, survey days were not required to be consecutive; caregivers could choose to participate on 4 consecutive weekends, one consecutive week, or any other time frame (provided the days fell within the ± 2-week interval) to ensure that days were chosen where caregivers would be with the infant as much as possible.

The number of weekend days selected by caregivers (out of 7) ranged from 0 (21.5% of participants were surveyed only on weekdays) to 7 (5.4% of participants were surveyed only on weekends) with an average of $M$ = 2.3 weekend days ($SD$ = 2.0). If infants' routines on the weekend versus weekday lead to different body position frequencies (as described below), variation in the number of weekend days could potentially bias the results and reduce the generalizability. However, the number of weekend survey days did not significantly predict body position or location frequencies, $r$s = -.06 to .12, $p$s > .26. Moreover, the number of weekend days did not significantly differ between age groups in a one-way ANOVA, $F(3, 89) = .733$, $p = .533$.

**Schedule of survey notifications.** Caregivers provided an earliest and latest allowable time for each of the seven days based on the infant's typical wake and sleep times. The goal was to spread 5 notifications across each day while making the exact time unpredictable. To do so, a random number of minutes (0-90) was added to the start time and a different random number of minutes (0-90) was subtracted from the end time. Within this modified interval, 5 evenly spaced notification times were created to ensure that different parts of the day were sampled. The night before each scheduled day, an automated text message was sent to the caregiver as a reminder that that the following day would be a test day. An online text message system (ohdontforget.com) was used to schedule notifications so that they were sent automatically at the specified time.

**Survey.** Each text message contained a link to a 3-item Qualtrics survey that could be completed in 1 minute. Caregivers were instructed to complete the survey immediately unless it would create an unsafe situation (e.g., driving in the car, changing the infant on a high surface). If caregivers were unable to immediately respond, they were instructed to remember the baby's position at the moment they heard the phone notification.

The first item asked, "Are you able to complete the survey right now?", to which caregivers could respond "No, my child is sleeping", "No, I haven't been with my child for the last five minutes", or "Yes, I have been with my child for the last five minutes". Subsequent data were analyzed only if the caregiver replied "Yes" to ensure that responses were based on immediate observation of infants' position and that responses reflected only infants' awake time.

The second item instructed caregivers to "Indicate the position your child is in right now" from the options shown in Figure 1 (this image was displayed in the survey for caregivers to reference). *Held* was scored if caregivers were holding infants in their arms, on their lap, or in an infant carrier. If infants were on a caregivers' lap in a position that resembled one of the other categories (e.g., an infant standing or sitting on the caregiver's lap), the position was still scored as held. However, holding was not scored if infants were sitting or upright on the floor or on furniture with caregivers' support. *Supine* was lying flat on the back. *Reclined* was lying tilted back at approximately a 45° angle, such as in a car seat or swing. *Prone* counted as any position with belly towards the ground, including lying face down, stationary while propped up on hands and knees/feet, and any type of crawling. *Sitting* indicated a seated position with the back vertical to the ground and included independent sitting or sitting in infant furniture, such as a high chair or "bumbo" seat. *Upright* was scored when infants were standing independently, standing holding onto a caregiver or furniture for support, or walking.

An "other" category was included in case caregivers were unsure of how to code the position but was selected only 2.0% of the time. In these instances, caregivers could describe the position and/or take a photograph to allow the experimenter to select the code. Most often, "other" responses occurred when infants were in a jumper or "exersaucer" (coded as upright), lying on their sides while breastfeeding but not on the mother's lap (coded as held), or kneeling (coded as sitting). Excluding all "other" responses rather than using the recoded items did not qualitatively change the results.

The third item asked about the child's location: "Is your child on the ground or on a raised surface right now?", to which caregivers could reply "on the ground" or "on a raised surface". On the ground was counted as anything less than 2 feet high to include times when infants were sitting in car seats or other infant furniture that was only slightly raised off the ground.

**Exit phone call and motor milestones.** After the 7 survey days, the experimenter completed a 5-minute exit phone call with the caregiver to assess infants' motor milestones through a structured interview (Adolph, Vereijken, & Shrout, 2003). Caregivers reported whether infants could sit (tripod sitting and/or independent sitting for 30 s without falling), crawl 10 feet across the floor (belly crawling and/or hands and knees crawling), and walk 10 feet across the floor (unaided, without stopping or falling). If infants were able to perform a skill, caregivers reported the onset date for that skill.

### Data Analysis

Normalized body position frequencies were calculated for each participant based on the number of available responses. The few times when caregivers were unavailable to respond because they were away from the child ($M$ = 2.8%, $SD$ = 4.1) were excluded. To focus exclusively on body position as it relates to opportunities for learning, times when infants were sleeping ($M$ = 20.1%, $SD$ = 11.3) were excluded. Thus, frequencies for each position category were calculated by summing the number of samples in that category and dividing by the total number of available awake samples. A score of 0% was entered if a position was never recorded for that participant.

Because position frequencies were measured as percent of samples and scores for some positions were at the floor (0%), assumptions for parametric tests could not be met. Instead, permutation versions of ANOVAs and t-tests were used because they do not require the strict assumptions of parametric tests (Edgington & Onghena, 2007; Nichols & Holmes, 2002). Permutation tests create null distributions for a test statistic (i.e., $F$ and $t$) by randomly swapping data between groups many times and recalculating the test statistic each time based on the randomized data. For example, a null distribution for a t-test comparing the percentage of time infants were supine between 3 and 6 months can be derived by randomly shuffling supine percentages across the two age groups 5000 times and calculating 5000 t statistics based on each iteration of the shuffled data. The statistic obtained from the actual data is then compared to the shuffled null distribution; the p value for the test is calculated as the proportion of iterations in which the observed statistic exceeds the statistic from the shuffled data and is then compared to a predetermined alpha level. If the test statistic is more extreme than the null distribution values calculated by shuffling the data, it is unlikely that the groups are equal. Analyses were performed in *R* using the *ez* package with 5,000 iterations for each test. *P* values were adjusted for multiple pairwise comparisons using the Holm-Bonferroni correction.

## Results

Results are organized according to the three aims of the study: 1) Characterize age-related changes in body position and location, 2) Determine how motor skill acquisition relates to body position, and 3) Assess the efficacy of the novel EMA method.

### Age-related changes in body position and location

Body position and location were strongly related to age: Table 1 and Figure 2 show the overall age-related changes for

Table 1
*Descriptive statistics for the frequency of samples observed (as a percentage of awake and available samples) for each position and for location (collapsed across positions) at each age, M (SD).*

| Position | 3 months | 6 months | 9 months | 12 months |
|---|---|---|---|---|
| Held | 49.8 (14.2) | 34.0 (14.6) | 20.4 (11.9) | 18.0 (9.1) |
| Supine | 18.3 (8.7) | 16.6 (10.7) | 5.4 (6.0) | 5.0 (7.4) |
| Reclined | 24.4 (10.6) | 19.2 (8.4) | 15.7 (7.1) | 12.9 (9.8) |
| Prone | 2.9 (4.7) | 9.2 (9.9) | 13.2 (9.2) | 7.2 (8.2) |
| Sitting | 3.0 (3.7) | 11.7 (8.7) | 30.5 (13.0) | 32.8 (14.5) |
| Upright | 0.6 (1.7) | 5.5 (6.2) | 12.5 (10.7) | 22.0 (11.1) |
| On ground | 24.3 (14.8) | 32.2 (12.5) | 44.0 (12.1) | 48.4 (19.6) |

each body position and for infants' location. At 3 months, infants spent the majority of the time held, supine, and reclined, but by 12 months infants were most often sitting and upright. A 4 age group × 2 location (on ground versus off ground) permutation ANOVA tested main effects of age and location and tested location × age group interactions for each body position (Table 2). Because the primary aim was to characterize overall age-related changes in body position over the first year, I first describe the main effects of age and pairwise comparisons between age groups before discussing how body position, location, and age relate.

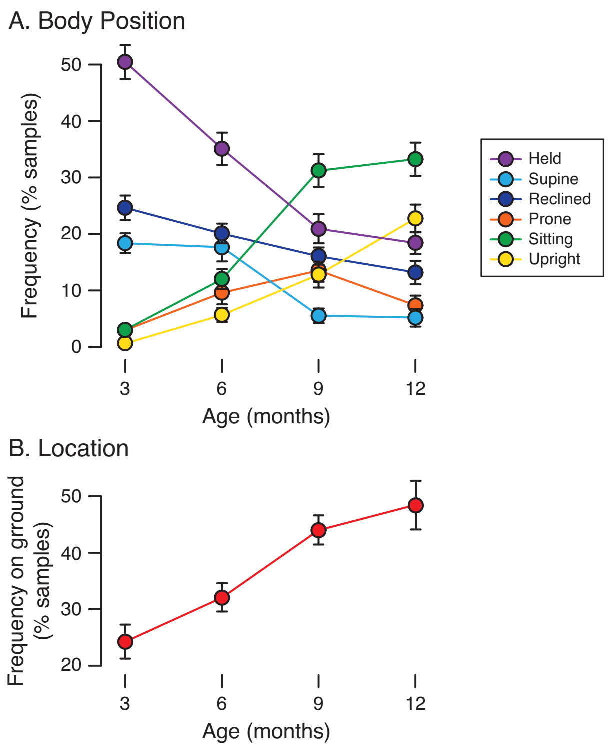


*Figure 2*. Mean frequency of (A) each of the six body positions and (B) infants' location on the ground at each age. Frequencies are calculated as the percent of samples, excluding times when caregivers were unavailable and when infants were asleep. Error bars show ± 1 SE.

**Age-related change in body position.** Each body position changed significantly with age (Figure 2A). Table 2 shows main effects of age and Table 3 shows pairwise comparisons between each age group. Based on the effect sizes in Table 2, the largest changes occurred in held, sitting, and upright positions. Held showed a large decrease over age, with 3-month-olds held during 49.8% of samples but 12-month-olds held during only 18.0%. Significant pairwise differences were observed between 3-6 and 6-9 months of age. In contrast, sitting and upright showed substantial increases with age, with only 3.0% sitting and 0.6% upright samples at 3 months compared with 32.8% sitting and 22.0% upright samples at 12 months. Sitting and upright both showed significant increases from 3-6 and 6-9 months, and upright significantly increased from 9-12 months. Age-related changes in supine, reclined, and prone positions, although statistically significant, were less pronounced compared to the changes in held, sitting, and upright positions. Supine and reclined positions became less frequent with age, but with the exception of a decrease in supine from 6-9 months, pairwise comparisons between successive ages failed to reach statistical significance. Prone was unique among body positions because it did not change monotonically: Prone increased from 3 to 9 months and then decreased from 9 to 12 months. However, the apparent decrease from 9 to 12 months was not significant; pairwise comparisons only revealed significant differences between 3 to 6 and 3 to 9 months.

**Age-related change in location.** Across body positions, infants were more frequently on the ground with age (Table 1, Figure 2B), increasing from 24.3% at 3 months to 48.4% at 12 months. Testing frequency on the ground by age group in a one-way permutation ANOVA revealed a significant age effect, $F(3, 90) = 12.52$, $p < .0001$, $\eta^2 = .29$. Significant pairwise permutation tests were found when comparing on the ground frequencies between ages 3-9, 3-12, 6-9, and 6-12 (ps < .01).

**Relations between body position and location.** Figure 3 shows that body positions varied in how frequently they occurred on versus off the ground. Two positions, prone and upright, almost always occurred on the ground, as indicated by significant main effects of location, with significant location × age interactions demonstrating that age-related increases in prone and upright positions occurred on the ground rather than off the ground (Table 2). Two positions, supine and sitting, were equally distributed between on the ground and off the ground at each age. Neither the main effects of location nor the location × age interactions approached significance for supine and sitting. Both reclined and held positions occurred more frequently off the ground, as shown by significant main effects of location. Age-related changes

Table 2
*Results of 2 location (on ground versus off ground) × 4 age group permutation ANOVAs for each body position.*

| | Age | | | Location | | | Age × Location | | |
|---|---|---|---|---|---|---|---|---|---|
| Position | *F* | *p* | $\eta^2$ | *F* | *p* | $\eta^2$ | *F* | *p* | $\eta^2$ |
| Held | 30.89 | < .001 | .33 | 353.31 | < .001 | .68 | 24.16 | < .001 | .30 |
| Supine | 15.21 | < .001 | .17 | 1.96 | ns | .01 | 0.42 | ns | .01 |
| Reclined | 6.80 | .004 | .08 | 57.14 | < .001 | .28 | 2.30 | ns | .04 |
| Prone | 6.34 | .004 | .10 | 34.73 | < .001 | .16 | 5.24 | .016 | .08 |
| Sitting | 44.25 | < .001 | .31 | 0.002 | ns | < .01 | 0.08 | ns | < .01 |
| Upright | 29.58 | < .001 | .32 | 81.73 | < .001 | .32 | 19.42 | < .001 | .25 |

in the reclined position occurred both on and off the ground (no significant interaction), whereas changes in holding occurred solely off the ground (significant interaction). Significant pairwise comparisons between locations are shown for each age and position by asterisks on Figure 3.

## Relation between motor skill and body position

To determine the influence of motor skills on body position frequencies, motor skill status was determined for each infant based on skill onset date relative to survey date. If infants began a skill between the first and last test dates, they were categorized as possessing the skill if 4 or more of the survey dates (> 50%) occurred after skill onset (this was the case for 4 6-month-old sitters, 4 9-month-old crawlers, and 6 12-month-old walkers). The goal of each analysis was to determine whether skill onset predicted greater experience compared to infants who had not yet achieved the ability, and, in turn, whether older infants who had not yet achieved the ability had greater experience compared with younger infants who also did not possess the ability.

**Sitting.** Age and skill both predicted sitting frequency (Figure 4). Sitting experience was compared between 3-month-old non-sitters ($n$ = 24), 6-month-old non-sitters ($n$ = 14), and 6-month-old sitters ($n$ = 11). Sitters included infants who could only tripod sit ($n$ = 3) or who could both tripod sit and sit independently ($n$ = 8). A one-way permutation ANOVA between the three groups revealed a main effect of group on sitting frequency, $F$ = 16.09, $p$ < .0001, $\eta^2$ = .41. Sitters sat more frequently ($M$ = 15.8%, $SD$ = 9.6) compared with 6-month-old non-sitters ($M$ = 8.5%, $SD$ = 6.6), who in turn sat more frequently compared with 3-month-old non-sitters ($M$ = 3.0%, $SD$ = 3.7); permutation pairwise comparisons between all three groups were significant ($p$s < .05).

**Prone.** Prone experience was marginally related to age and crawling ability (Figure 4). Prone experience was compared between 6-month-old non-crawlers ($n$ = 25), 9-month-old non-crawlers ($n$ = 5), and 9-month-old crawlers ($n$ = 17). Crawlers included infants who could crawl on hands

Table 3
*Significant permutation pairwise comparisons are shown for each age group and position (collapsed across location) and for location (collapsed across positions); p values were adjusted with Holm-Bonferroni corrections for 6 tests.*

| Position | 3 mo | 6 mo | 9 mo | 12 mo |
|---|---|---|---|---|
| Held | 6†, 9‡, 12‡ | 3†, 9†, 12‡ | 3‡, 6† | 3‡, 6‡ |
| Supine | 9‡, 12‡ 9‡, | 12‡ | 3‡, 6‡ | 3‡, 6‡ |
| Reclined | 9*, 12† | | 3* | 3† |
| Prone | 6*, 9‡ | 3* | 3‡ | |
| Sitting | 6‡, 9‡, 12‡ | 3‡, 9‡, 12‡ | 3‡, 6‡ | 3‡, 6‡ |
| Upright | 6†, 9‡, 12‡ | 3†, 9*, 12‡ | 3‡, 6*, 12* | 3‡, 6‡, 9* |

*$p$ < .05 †$p$ < .01 ‡$p$ < .001

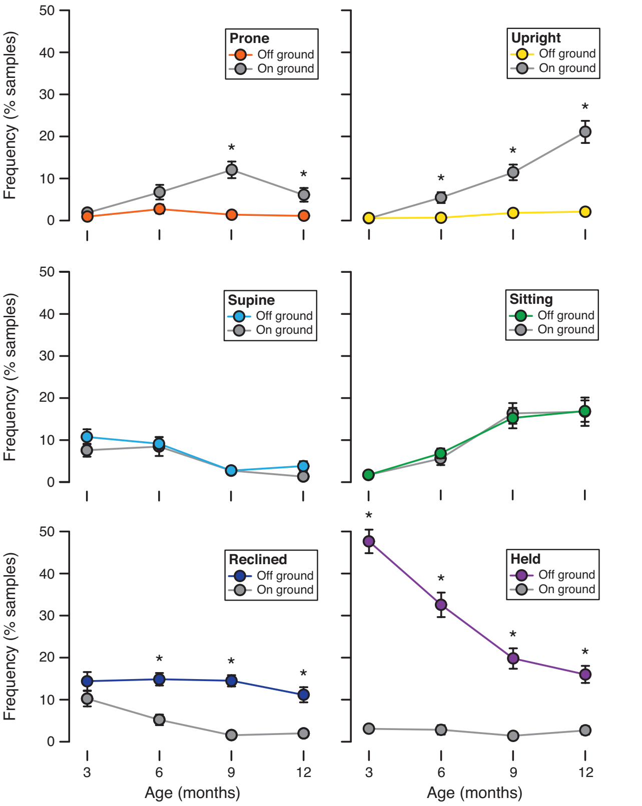


*Figure 3.* Mean frequency of body positions located on the ground (gray circles) versus off the ground (colored circles) as a function of age. Error bars show ± 1 SE.


*Figure 4*. Frequency of body positions divided by age and motor skill. Squares show sitting frequency as a function of age and sitting ability. Triangles show prone frequency as a function of age and crawling ability. Circles show upright frequency as a function of age and walking ability. Data are offset for clarity. Error bars show ± 1 SE.

and knees/feet ($n$ = 14) as well as those who could only belly crawl ($n$ = 3). Although the one-way permutation ANOVA between groups reached significance, $F$ = 3.20, $p$ = .045, the effect size ($\eta^2$ = .13) was small. Furthermore, no pairwise comparisons were significant between 9-month-old crawlers ($M$ = 15.4%, $SD$ = 9.1), 9-month-old non-crawlers ($M$ = 5.7%, $SD$ = 4.6), and 6-month-old non-crawlers ($M$ = 9.2%, $SD$ = 9.9).

**Upright.** Walking ability had a profound effect on upright experience that could not be accounted for by age (Figure 4). Upright experience was compared between 9-month-old non-walkers ($n$ = 22), 12-month-old non-walkers ($n$ = 14), and 12-month-old walkers ($n$ = 9). A one-way permutation ANOVA indicated that upright experience between the three groups significantly differed, $F$ = 11.48, $p$ < .001, $\eta^2$ = .35. Unlike sitting, which showed significant differences due both to age and sitting ability, upright experience only differed according to walking ability. Non-walkers were upright for similar frequencies at 9 ($M$ = 12.5%, $SD$ = 10.7) and 12 months ($M$ = 16.4%, $SD$ = 8.0), permutation test $p$ = .25. Walking 12-month-olds stood about twice as often ($M$ = 30.8%) compared with the other two groups ($p$s < .01).

### Efficacy of the EMA method

The EMA method was successful based on the high percentage of completed responses, the relative short response lags, and the even spread of responses across the day. Caregivers dependably completed survey requests, responding to 3,173 (95.6%) of the 3,318 notifications sent over the entire dataset (an additional 7 notifications were never sent due to software issues). This response rate compares favorably to typical rates of 80-95% in prior EMA studies (Kamarck et al., 2002; Kimhy et al., 2006; Shiffman et al., 2008; Stone et al., 2003) and exceeds the 85% compliance obtained in a study that surveyed caregivers of young children (Williams et al., 1991).

To determine how promptly caregivers responded to notifications, response lag was calculated as the difference in minutes between the time that the survey notification was scheduled to be sent and the time that the participant opened the survey on his or her smartphone (Figure 5A). A median response lag of 2.3 minutes indicated that most often participants responded quickly, and 75% of responses were made within 12.15 minutes, lags that are typical compared with past work (for a discussion, see Scollon et al., 2003).

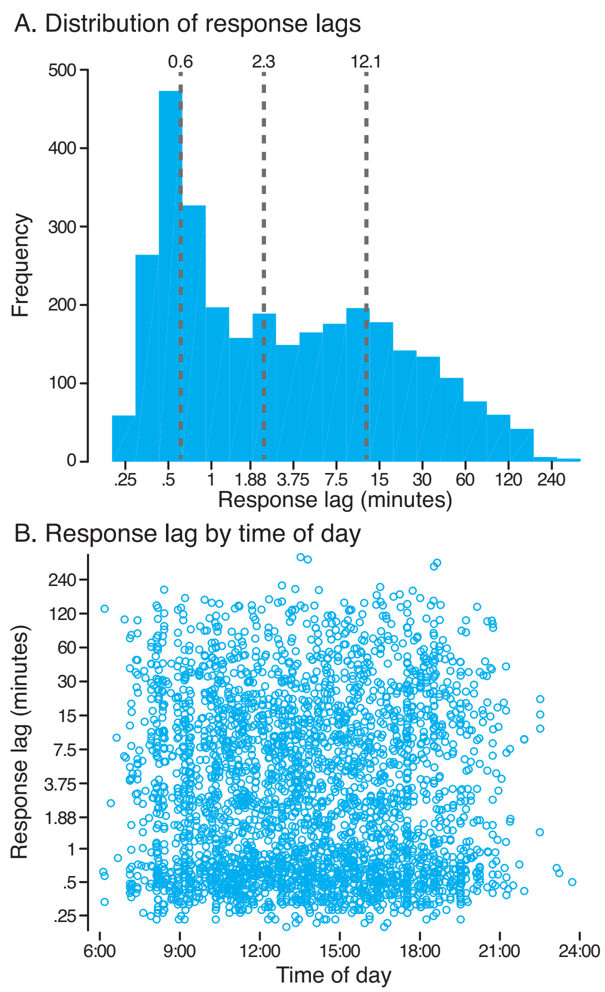


*Figure 5*. (A) Histogram of response lag (time between survey notification and response) and (B) scatterplot of response lag by time of day (each symbol is a single response). Response lag is plotted on a logarithmic scale for clarity. Dashed lines show 25th, 50th, and 75th percentiles.

A strong positive skew indicated that, on occasion, participants responded to notifications after extremely long delays. A potential concern was that longer response latencies might bias the results if caregivers waited to check their phones while infants were in particular positions. However, no qualitative differences in body position frequencies were found when dividing the dataset based on a median split of response lag, suggesting that longer response lags did not systematically bias the data. Another potential concern was that caregivers might be more likely to delay responding to notifications at different times of the day (e.g., during the morning or nighttime routines). If so, longer lags at certain times would interfere with the goal of distributing samples across the entire day. However, Figure 5B shows that length of response lag was independent of the time of day, indicating that the whole-day sampling procedure was successful.

## Discussion

A novel EMA method measured age-related changes in infant body position and location over the first year. Younger infants (3-6 months) spent more time held, reclined, and supine; with age, infants increasingly spent time sitting and upright. The prone position peaked at 9 months before declining at 12 months. Across positions, older infants spent more time on the ground compared with younger infants. Positions varied with regard to whether they occurred mostly off the ground (held, reclined), mostly on the ground (prone, upright), or equally on and off the ground (sitting, supine). The results provide strong evidence that infants' motor skills directly impact the physical context of their everyday experiences. Infants who could independently sit and walk spent more time sitting and upright, respectively, compared with their same-age counterparts who had not yet achieved those motor milestones. Evidence that the onset of crawling led to increased time prone was inconclusive. Finally, the dependability and promptness of responses by caregivers suggest that this novel EMA methodology can be profitably adopted to study various naturalistic behaviors where direct observation and broad time-sampling are needed.

### What accounts for changes in body position?

Although some past work has reported the frequencies of body positions in everyday life (Bril & Sabatier, 1986; Karasik et al., 2015; Majnemer & Barr, 2005), the current study is the first to measure across a wide age range to estimate changes in body position frequencies over the first year of life. Some changes—decreases in time spent held and increases in time spent sitting and upright—dramatically altered the composition of infants' daily experiences. At 3 months, infants were held for about half their waking hours and spent nearly the remainder of their time supine and reclined. Sitting, upright, and prone accounted for < 7% of the day. By 12 months, those three positions accounted for 62% of infants' days as holding, supine, and reclined positions waned in frequency.

Some portion of the change can be attributed to motor development. Although infants who could not yet sit or walk independently could, and did, experience supported sitting and upright postures, the ability to sit nearly doubled the amount of time that 6-month-olds spent sitting (an increase of 7.2%), and the ability to walk nearly doubled the amount of time that 12-month-olds spent upright (an increase of 14.4%). These results confirm patterns found in shorter home and laboratory observations—Karasik and colleagues (2015) found more sitting experience in sitters compared to non-sitters, and Franchak and colleagues (2018) found more upright experience in walkers compared to crawlers. The current study goes a step farther to show that these benefits are found when looking at an entire day rather than a single, short observation. It is unclear whether crawling ability is associated with time spent prone—9-month-olds who could crawl spent 9.7% more time prone compared to 9-month-old non-crawlers, however, the difference was not reliable. Because most infants in the sample were crawling at 9 months (17 versus 5), observing infants at an earlier age with a more even distribution between crawlers and non-crawlers might have revealed a conclusive result.

Some portion of the change in body position must also be attributed to caregivers. The youngest infants in the study (3 months) are entirely dependent on caregivers to change their body position as few infants can shift between positions at such a young age. For older infants, choosing to sit or stand is only an option if caregivers provide opportunities to do so. Increasing time spent on the ground over the first year of life (from 24% at 3 months to 48% at 12 months) suggests that caregivers provide more opportunities for older infants to practice developing motor skills and thus to choose how to transition between positions. Both the current study and past work suggest that time spent reclined in infant furniture and held off the ground gives way to allow older infants more time in unrestricted activity (Hesketh, Crawford, Abbott, Campbell, & Salmon, 2015). This shift likely depends on caregivers recognizing improvements in infants' motor abilities, caregiver beliefs about promoting motor abilities (Keller, Yovsi, & Voelker, 2002), beliefs about safety (Hnatiuk et al., 2013), as well as non-motor changes in infant development (e.g., the ability to self-soothe may allow infants to be held less often). Changing caregiving requirements, such as less time spent feeding (Fausey et al., 2015), may free up time to allow caregivers to provide more unrestricted play time.

More research is needed to know how caregivers' use of positioning equipment changes with infants' age and motor development to affect body position. Given the widespread use of positioning equipment (Pin, Eldridge, & Galea, 2007), it is likely an important factor. Over 80% of caregivers of 8-

month-olds report using positioning equipment, and of those, the majority place children in equipment for at least an hour per day (Abbott & Bartlett, 2001). Furthermore, caregivers vary widely in terms of how often they place infants in positioning equipment: Infants under 5 months of age spend an average of 5.7 hours in seating devices with a range of 0 to 16 hours (Callahan & Sisler, 2007). A study of premature 8-month-olds revealed a range of 0.75 to 14.2 hours per day in various positioning devices (Bartlett & Kneale Fanning, 2003). Use of equipment like baby walkers and "exersaucers" is often for convenience—restraining infants allows caregivers to perform other tasks—and is more common in families with multiple children (Crouchman, 1986; Fay, Hall, Murray, Saatdjian, & Vohwinkel, 2006). Caregivers may also choose to use equipment due to beliefs about devices enhancing infants' motor development, despite most evidence suggesting that positioning devices have either no effect on motor abilities or lead to temporary motor delays (Abbott & Bartlett, 2001; Bartlett & Kneale Fanning, 2003; Crouchman, 1986; Fay et al., 2006).

## Implications of changing body position for other areas of development

Changes in naturalistic body position have implications for developmental change in other abilities. Because body position determines infants' viewpoint, changes in how long infants spend in different positions might contribute to age-related decreases in availability of faces in view (Fausey et al., 2016; Jayaraman et al., 2015). Infants rarely see faces while playing on the ground in sitting, upright, and prone positions, but see faces more often when held or sitting off the ground (Franchak et al., 2018; Franchak et al., in preparation; Kretch & Adolph, 2015; Kretch et al., 2014; Yu & Smith, 2013). Most likely, reclined and supine infants (either on or off the ground) can easily see caregivers' faces because their heads are pointing upwards. Based on the results of the current study, the amount of time infants spend in positions in which viewing faces is more difficult (upright, sitting, prone on the ground) increases as time spent in positions known to be more conducive (held and sitting off the ground) and likely to be more conducive (reclined and supine in any location) to viewing faces decreases. These results highlight the need to study infants' access to faces in reclined and supine postures—two positions that occupy much of young infants' time but for which we know little about. Of course, body position does not tell the whole story, as infants can choose how to angle their heads within a body position to choose what is in view. Older infants increasingly bias their views to contain objects rather than faces (Franchak et al., in preparation), which may also contribute to decreasing views of faces. Finally, potential influences of body position on face looking change concurrently with other factors, such as the developmental shift in attention from faces to objects (de Barbaro, Johnson, Forster, & Deak, 2015), so more work is needed to understand how body position fits within the entire attentional system.

Prior work links the attainment of independent sitting to earlier achievements in object perception and cognition, presumably mediated through changes in everyday experiences associated with increased sitting (Ross-Sheehy et al., 2016; Soska et al., 2010). However, because only crude metrics of experience (e.g., how many days of sitting experience had infants accrued) had been collected in past work, it was unknown how experience changes after learning to sit. The current study addresses this shortcoming by showing that infants who can sit independently receive nearly twice the everyday sitting experience compared with infants who cannot. Consequently, sitting infants have twice as much opportunity to experience the richer visual-manual exploration of objects that infants perform while sitting compared to while prone or supine (Soska & Adolph, 2014). Given how rapidly infants learn over the first months of life, such a marked difference in experience could account for the earlier achievement of certain object perception skills in sitting infants (Ross-Sheehy et al., 2016; Soska et al., 2010).

## Efficacy of ecological momentary assessment for recording infants' everyday experiences

The novel EMA method used in the current study has several advantages compared to methods used in past work, suggesting it may be widely applicable for studying other aspects of infants' everyday experiences. Compliance measures indicate that the EMA procedure was not overly burdensome for caregivers. They responded to the majority of notifications and did so quickly, with response rates and responses lags that compare favorably to prior EMA studies (Kimhy et al., 2006; Scollon et al., 2003; Stone et al., 2003; Williams et al., 1991). Responding to a short survey five times a day over several days meant that the time commitment was spread out so that caregivers were not required to do much at any single time. This may be less obtrusive compared to having an experimenter in the home for an hour or having to fill out diaries to account for long periods of time. Moreover, most of caregivers' responses were made within a short window following the notification, so the demands on caregivers' memory were minimal compared to diary methods that asked caregivers to estimate activity over a multiple-hour period.

Because of differences in coding categories and age groups, it is difficult to evaluate how the results of the current study compare with measures from past work. The most direct comparison is between the 6-month-olds in the current study compared with those from Majnemer and Barr (2005). Supine and prone measures were similar between the two studies, with differences less than 5%. There was a larger discrepancy between the two studies for how often infants were held, 34.0% in the current study compared with 25.7%, and for how long they spent in seated positions—30% in the current study (combining sitting and reclined) compared with 47.6% (combining "supported sitting" and "unsupported sitting" categories). There are several reasons for these discrepancies. First, the accuracy of reporting might differ between the diary method (memory limitations) and the immediate responses in the current study. Second, differences in the coding scheme might contribute: Behaviors such as infants sitting in a caregivers' lap would be coded as held in the current study but might have been counted as supported sitting by Majnemer and Barr (2005). Finally, differences in the motor skills of infants in the two samples could also lead to discrepancies. Regardless, the broad pattern of results between the two studies was similar—6-month-olds spend significant time held and in various seated positions but spend less time supine and prone.

Moreover, the results of the current study clearly show that measuring everyday body position depends on sampling across a variety of daily activities (Tamis-LeMonda et al., 2017). Laboratory play sessions may generalize well to play time but differ pointedly with those from the current study based on whole-day sampling. The amount of time spent sitting by 6-month-olds ( 75%) in a laboratory play session (Thurman & Corbetta, 2017) was twice as much compared to whole-day estimates from the current study ( 30%, combining sitting and reclined to equate coding schemes). Similarly, estimates for time spent upright in newly-walking infants ranges from 50-70% of the time in laboratory investigations (Franchak et al., 2018; Thurman & Corbetta, 2017) compared to 30% for 12-month-old walking infants in the current study. A more comprehensive accounting of how infants spend time in different activities (Fausey et al., 2015) will help determine how and whether different laboratory tasks relate to everyday life.

Future work can capitalize on the benefits of EMA for studying other aspects of infants' daily lives. A wide variety of experiences can be studied if they can be distilled into 3-4 short questions with a coding scheme that is easy for caregivers to follow. For example, sedentary time (e.g., TV watching, passive play) versus active time (unrestricted movement) in infancy relates to health and developmental outcomes, but studies have relied on crude caregiver report measures or more expensive, technically demanding accelerometer measurements (Downing, Hnatiuk, & Hesketh, 2015; Hesketh et al., 2015; Hnatiuk et al., 2013). Opportunities for learning about objects (Ross-Sheehy et al., 2016; Soska et al., 2010) could be measured by categorizing the how often infants manipulate objects and the types of objects encountered.

## Conclusion

Theorizing about the mechanisms of development depends on acquiring rich data that describe infants' opportunities for learning in everyday life. Yet, such data are in short supply. A revitalized interest in studying naturalistic experiences promises to address this gap in our knowledge (Dahl, in press). Body position is just one of many developmentally-relevant experiences that needs to be measured. Unless body position proves to be an unusual case, the current results suggest that the landscape of infants' everyday experiences is constantly shifting. Moreover, diverse factors, such as infants' developing abilities and caregivers' priorities and practices, contribute to those changes. Future work using rich methods, such as ecological momentary assessment, to collect naturalistic data about everyday experiences will help reveal how and why those experiences change over development.

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Supplemental Materials

## Body Position Survey Study Instructions Provided to Participants

Thank you for your interest in this study. This manual explains what will happen during the study and provides instructions about receiving survey notifications and how to respond to the notifications.

## Study Schedule

### Introductory Phone Call

When you were first contacted about participating in the study, you made an appointment for the introductory phone call. A researcher from our lab will call you to explain the informed consent agreement, go over this manual, and to help explain the survey. Please have all of the documents you received in the email available for the introductory phone call. The phone call will last approximately 20 minutes.

If you agree to participate, you will receive an email link to a questionnaire that asks you your availability for the survey. Please follow the link and enter your information to schedule seven days during which you will be available to complete the survey.

By completing this information you give your consent to participate in the study and your phone will be registered to receive survey notifications.

### Seven Survey Days

During each of the survey days, you will receive 5 text messages spread throughout the day on your mobile phone. Those messages are notifications to complete the survey as soon as it is safe and possible to do so. You will use your phone to answer the 3 survey questions (explained in the next section). Each survey response should only take about 1 minute.

We want this survey to be as convenient for you as possible. So, we would like you to choose **seven days** when you think it would be convenient to complete the survey. Please choose days during which you expect to spend most of the time with your child. The days do <u>not</u> have to be consecutive. Please choose days within the next 4 weeks, and please indicate the earliest and latest times we can notify you to complete the study for each day.

### IMPORTANT SAFETY NOTICE

Survey notifications will come as text messages to your mobile phone. While we encourage you to respond to the survey in a timely manner, it is important to do so safely. If you receive a text notification while you are driving, **<u>DO NOT RESPOND</u>.** Please wait until you have finished driving, and complete the survey at that time, if possible. **<u>Only respond to text messages when it is safe to do so.</u>**

### Exit Phone Call

After the last survey day, the experimenter will schedule a 5-minute phone call with you to answer any questions that you have about the study. At that time, we will also ask you a few short questions about your child's motor skills: when he or she started sitting, standing, crawling, and walking. If you notice that any of these milestones occur during the course of the study, please try to keep a record of the date so that you will be prepared during the exit phone call.

## How to Answer the Survey Questions

You will answer the same three questions each time you are notified. During the introductory phone call, the researcher will explain each of the questions to you in greater detail. Keep this manual as a reference in case you are ever confused about the survey questions.

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**1. Are you able to complete the survey right now?**

- ◯ No, my child is sleeping.
- ◯ No, I haven't been with my child for the last 5 minutes.
- ◯ Yes, I have been with my child for the last 5 minutes.

In order to answer the survey questions, you must have been in the vicinity of your child for the last 5 minutes and your child must be awake. For example, if your child is with another caregiver and you leave the house to run an errand, or your child is freely moving and switching positions in another room out of your line of vision, select 'No, I haven't been with my child for the last 5 minutes'. If you can report on your child's activities for the last 5 minutes, select 'Yes'.

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**2. Please indicate which of the following positions your child is in right now (choose only one):**

- ◯ Prone (lying on belly, crawling on hands/knees)
- ◯ Supine (lying on back)
- ◯ Reclined (tilted back, like sitting in car seat or swing)
- ◯ Sitting up (independently or in furniture like a high chair)
- ◯ Standing upright (independently, while holding on for support, or walking)
- ◯ Held by caregiver (held in arms or in a sling or carrier)
- ◯ Other (please specify or take a photo)

For Question 2, look at your child and select the position they are currently in, based on the definitions below. Note, if you have changed your child's position to fill out the survey questions (for example, you were holding your child and you put him/her down to respond), please indicate the position your child was in when you received the notification.

**Prone (lying on belly, crawling on hands/knees, crawling on belly)**




**Supine (lying on back)**


**Reclined (tilted back at a 45 degree angle, like in a car seat or swing)**

**Sitting up (independently or in furniture like a high chair)**

**Standing upright (independently, while holding on for support, or walking)**

**Held by caregiver (held in arms or in a sling or carrier)**

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Question 3 asks about how high up your child is at the moment you receive the notification:

Is your child on the ground or on a raised surface right now'

- ◯ On the ground, < 2ft high
- ◯ On a raised surface > 2ft (crib, high chair, couch, etc.)

**Training quiz**

Please identify the infant's position in the following photographs:

A)

B)

C)

D)

E)

F)

G)

H)

Correct answers (not displayed in the instruction manual):

A) Held

B) Sitting

C) Held

D) Upright

E) Reclined

F) Sitting

G) Prone

H) Supine