FROM LOCOMOTION TO LANGUAGE: DEVELOPMENTAL CHANGES IN INFANTS' EVERYDAY LEARNING OPPORTUNITIES

By

Madelyn Caufield

A capstone project submitted for
Graduation with University Honors

June 1, 2020

University Honors
University of California, Riverside

APPROVED

____
Dr.John Franchak
Department of Psychology

____
Dr. Richard Cardullo, Howard H Hays Jr. Chair, University Honors

Abstract

Rapid changes in the locomotor abilities of infants around the end of the first year are associated with improvements in language development (Walle & Campos, 2014). It is unlikely that locomotion directly leads to language development, rather there are intermediate changes to the everyday experiences of infants. For instance, walking infants are better able to access objects and move about independently (Karasik, Tamis-LeMonda, & Adolph, 2011) which could lead to more language interaction. However, it is unclear exactly how often children are engaging in these activities. This study assesses two variables that could aid in language development around the end of the first year: frequency of object interaction and time spent unrestrained. Parents of infants were recruited to participate in a four-month longitudinal study to report measures of infants' everyday experiences from 10 to 13 months old. Parents were sent automated text message surveys throughout their infant's waking day, prompting parents to report whether infants were currently holding objects and whether their infants were restrained by a baby device or caregiver. Data reported reflects the completed sessions for 10-11-month-olds. Findings indicate that 10- and 11-month-olds spend 58.08% of their waking hours holding objects and 47.31% of their waking hours unrestrained. Data collection for sessions at 12 and 13 months are ongoing with future research looking at how these everyday behaviors may change as infants near the end of their first year. A language assessment at 13 months will determine whether these behaviors are related to subsequent language proficiency. We will assess two potential intermediate variables' influences on language development. It is predicted that infant-object interaction and time spent unrestrained will increase following onset walking. Furthermore, we hypothesize that these increases will create more opportunities for learned language.

From locomotion to language: Developmental changes in infants' everyday learning opportunities

As infants near the end of the first year, they begin to experience major developmental changes in multiple domains. For instance within the language domain, on average infants begin saying their first words by 10-13 months (Swingley, 2008). Fine and gross motor development allows infants to pick up food to feed themselves by 4-7 months (Wright, Cameron, Tsiaka, & Parkinson, 2010), and take their first independent steps by approximately 12 months (Adolph, Berger, & Leo, 2011). An intriguing finding from developmental studies that investigate these multimodal changes is that locomotor abilities of infants are associated with improvements in language development. Walle and Campos (2014) showed that infant language development accelerates following the acquisition of the ability to walk, independent of age. While this indicates that language and locomotion are developmentally connected, it is unlikely that acquiring the ability to walk directly leads to increases in language development. In this study we explore what kind of intermediate changes in opportunities that exist following walking that lead to language development.

Locomotor abilities and the subsequent changes in experience that follow are the foundation for infants' everyday actions that promote cognitive development (Gibson, 1988)(Bushnell & Boudreau, 1993). The developmental cascade hypothesis is the idea that breakthroughs in one area of development leads to accumulation of changes in another. More specifically, it is the cumulative consequences that occur during development, resulting in a transfer of information across multiple domains and ultimately altering the course of development (Masten & Cicchetti, 2010). One fundamental feature of a developmental cascade are the downstream affects on later unrelated domains that ultimately alter the course of development (Franchak, 2019). For example, crawlers' gaze tends to drift down to the floor as compared to a walking infant who has a broader range of what is is visually available, resulting in more opportunities to explore the world around them (Kretch, Franchak, & Adolph, 2014).

In the current paper, we posit that there are developmental cascades that are present in the transition from crawling to walking that promote learning language. As infants gain further autonomy of their own bodies, the opportunities to engage in new experiences through these developmental cascades grows substantially, with early exploration appearing to play a key role in later development. The acquisition of a locomotor-related skill may initiate developmental cascades that can promote cognitive changes associated with that skill (Libertus & Violi, 2016). This knowledge points to the possibility of changes in exploratory behaviors following the onset of walking that could potentially serve in the increases in language ability around the end of the first year.

Walle and Campos (2014) found that infant receptive and productive vocabularies showed increases as a function of crawling versus walking. However, infants' experience many other developmental changes in the transition from crawling to walking that can promote language. For instance, developing the newfound ability to walk allots more freedom to use one's arms and hands, allowing for further navigation of the world not previously exposed to a crawling infant, whose options of interaction are limited (Karasik, Adolph, Tamis-LeMonda, & Zuckerman, 2012). Walking infants have greater freedom to use their hands and are better able to access distant objects, carry objects, and approach caregivers to share objects as compared to crawling infants (Karasik et al., 2011) which could promote opportunities to learn object names. It is plausible that infant-object interaction following walking, rather than learning to walk on one's own, is a major contributor to language development around the end of the first year. However, this increase in ability to interact with and manipulate objects has not been empirically tested to understand its impact on language development.

In addition to further exploration of objects, infants who are able to walk experience other everyday changes that may lead to enhanced language ability. Walking infants' may spend less time restrained by baby devices or caregivers which could lead to more opportunities for self-initiated social interaction. Baby devices are typically for convenience, and are an appropriate option for families with many children or caregivers of young infants who need to go about daily tasks (Crouchman, 1986)(Fay, Hall, Murray, Saatdjian, & Vohwinkel, 2006). However, caregivers confidence in their infants' new motor abilities is a likely contributor in the shift from majority of time spent restrained to unrestrained (Keller, Yovsi, & Voelker, 2002). Less time restrained allows for more freedom to move about independently, specifically to explore the stimuli that are present in the infant's environment. Further exploration of the environment as a result of time spent unrestrained is likely to contribute to the accumulation of knowledge in infancy. More specifically, increased opportunities for learning following an increase in infants' time spent unrestrained is a promising facilitator of language development at the end of the first year.

Infant development occurs rapidly on a scale of weeks and months, which makes it difficult to capture the full scope of change with the types of techniques most commonly used to date. It is clear that attaining full day data is necessary for understanding everyday experiences around the end of the first year, but actually assessing this is difficult. Researchers have used a range of data collection techniques to measure development in infancy. A primary method used to measure infants' interaction with their environment, specifically infant-object and infant-caregiver interaction, is an observational technique such as video recording. Video recording often occurs through controlled observation or observation conducted in the lab. This type of measurement allows for multiple observations to take place in a short amount of time. Despite being able to attain a large sample in a controlled environment, this methodology can often lack validity. For instance, participants may change their behavior to act more cooperatively if they know they are being watched (Bateson, Nettle, & Roberts, 2006).

Another common observational technique is naturalistic observation, seen by observing the infant in the home setting. Unlike in the lab, this allows the researcher to observe the natural flow of the infant in a familiar environment. However, these observations are often more time consuming and require the presence of trained researcher who is able to recognize aspects of a situation that are psychologically significant. Ultimately, there are a multitude of confounding variables that could affect an in lab or at home session such as time of day, presence of researcher, and infant mood.

Ecological Momentary Assessment, or EMA, is a form of data collection that eliminates a lot of the issues found in common methodological techniques. It involves repeated sampling of subjects' current activity in actual time, and in subjects' natural surrounding conditions (Shiffman, Stone, & Hufford, 2008). EMA aims to study real-world behavior by assessing subjects at randomized times using convenient forms of technology that can capture the scope of behavior over a longer period.

EMA is well suited for infant research because it can allow for non-intrusive reports of infant behavior often through the use of randomized text message surveys distributed to caregivers over an infants' full waking day (Franchak, 2019). The random distribution of text messages allows for accurate approximation of infant activity over a full waking day. While many studies measure behavior in the lab, EMA allows infants and parents to go about their daily home lives without the typical disruptions occurring in other forms of data collection. Additionally, EMA consists of full days of data collection, eliminating the issue of short observational session and biased in-lab behaviors. Furthermore, being a remote form of data collection, EMA is inclusive to all participants regardless of their current location. This inclusive method of attaining data allows for more accurate estimations of infants' daily experiences in their environment.

Current study

The current study explored changes in infants' opportunities for learning that occur as children begin to walk that may aid in vocabulary growth. The research looked at two probable intermediate variables that could assist in language development: how often infants interact with objects and how often infants spend time unrestrained around the end of the first year. To capture these developmental changes, the study collected longitudinal data of reported infant behavior from 10-13 months of age, a span of time over which most infants begin to walk (Adolph & Robinson, 2013). Unlike the bulk of the current literature pertaining to the developmental changes that arise around the end of the first year, the current study took an 'everyday experience' approach with the use of EMA. Parental reports occurred over infants' typical waking days in order to attain an accurate approximation of these activities. The current data acquired through EMA allows for further insight into *how often* these experiences are occurring over a full day, something that cannot be measured as accurately through other forms of data collection such as in lab or at home observational methods. By assessing the changes in learning opportunities that arise from the ability to walk, the current study contributes to the understanding of how walking impacts developmental changes beyond just motor abilities.

Method

Participants and design

The data reported here reflect completed sessions for $N = 10$ ($n = 5$ female) 10 and 11 month old sessions. Participants were scheduled to receive survey notifications ± 1 week of turning the target age at 10 and 11 months (e.g., 9.75-10.25 months for 10-month-olds). The mean start age for the first day of receiving notifications for 10 month olds was $M = 9.85$ months ($SD = 0.07$) and the mean age for the final day of receiving notifications for 10 month olds was $M = 10.08$ months ($SD = 0.10$). The mean start age for the first day of receiving notifications for 11 month olds was $M =$ 10.84 months ($SD = 0.02$) and the mean age for the final day of receiving notifications for 11 month olds was $M = 11.07$ months ($SD = 0.11$). Participants were recruited nationwide via Instagram and Facebook advertisements. After the completion of the study, participants will receive a $40 Amazon gift card for compensation.

A demographic assessment after the final session at 13 months will give us a more accurate count on which states the participants are from, as well as general information pertaining to the caregivers' socioeconomic status. Currently, there is 1 participant from the Western Time Zone, 3 participants from the Central Time Zone, and 6 participants from the Eastern Time Zone.

The study consisted of three main phases: an introductory phone call, longitudinal survey data collection, and an exit questionnaire. The longitudinal survey data collection phase was further divided into four monthly data collection sessions during the time in which the child was 10-13 months of age, with the target ages for data collection occurring at 10-, 11-, 12-, and 13-months-old. Each monthly session consisted of four days of data collection that occurred within ±1 week of the child turning the target ages. Caregivers selected data collection days when they were planning to be with their infant for the entire day. To be eligible to participate, the caregiver needed to have a mobile smartphone with internet access and a touchscreen interface. The study procedure was approved by the Institutional Review Board of the University of California, Riverside. Caregivers were informed that consent to participate was given when they clicked and proceeded to respond to survey data collection links.

Procedure

Introductory phone call. The study began with a 30-minute introductory phone call that served to orient and train the caregivers on the study procedure. An electronic copy of an instruction manual was provided to caregivers so that they could follow along as the experimenter walked through each essential part. During the call, the experimenter explained the survey text notification procedure and trained parents in identifying different forms of constraint, body position categories, activity contexts and when an infant is holding an object. To assist in caregiver's identification of these categories, photographs in the instruction manual presented possible variations of the criteria. At the end of the instruction manual, caregivers were presented with twelve unlabeled photographs to categorize into the different forms of restraint and positions. The experimenter did not proceed until the caregiver categorized the photographs with 100% accuracy. Lastly, caregivers provided their mobile phone numbers and time zones to allow for appropriately timed text notifications during the longitudinal survey data collection.

Survey data collection. Before the start of each session, caregivers were contacted over the phone to choose four days that occurred within ±1 week of their infant turning 10-months-old for which they planned to be with their child for the entire day. Parents were instructed to choose one weekend day and three weekdays to receive survey notifications in order to provide an approximate representation of behavior that biased sampling towards weekdays. Caregivers provided the earliest times they may begin receiving survey notifications for each of the four days based on the infant's typical waking hours. To sample the entirety of the day, ten notifications were sent each day. Notifications occurred once per hour ± a random interval up to 30 minutes, to ensure that notifications were semi-randomized. The night before their first survey day, an automated text notification was sent to the caregiver as a reminder that the following day would begin their four-day data collection session. An online SMS message API (Clickatell.com) was used to send text notifications automatically at the semi-randomized times. Over each four-day session, participants received 40 text notifications. This process was repeated as infants approached 11-, 12-, and 13-months-old.

Survey. Each text message notification included a link to a 6-item electronic survey administered using Formr (Arslan, Walther, & Tata, 2020). The survey was designed to be completed in under 1 min and asked about infant behavior at the moment the caregiver received the notification. Caregivers were told to complete the survey as soon as it was received but only if it was safe to do so. If they received the notification at a time in which the act of responding would lead to an unsafe situation, they were to not respond until it was safe and possible to do so. If under any circumstance, caregivers were not able to respond to the notification at the time they received it, they were informed that responses should reflect their infant's behavior at the moment they received the notification. Each link to the survey expired after 15 min, making the parent unable to answer for that survey notification but could resume responding to the next scheduled survey notification.

The first item of the survey asked, "Are you with your child? Is your child awake?" to which caregivers would respond "Child awake", "Child sleeping", or "Not with child". The caregivers would only be asked the remainder of the survey questions if they answered the first option. If the caregiver answered the "Child sleeping" or "Not with child", the survey would be complete .

The second item asked caregivers "Is your child..." with answer choices being "Restrained by device/furniture", "Restrained by caregiver", "Locomoting", or "Neither". Caregivers were instructed to select Restrained by device/furniture only if the device/furniture was meant for the use of a toddler or infant. This excluded any adult furniture. Restrained by caregiver indicated the child was being held off the ground, on lap, or by baby carrier. Locomoting was defined as independently moving from one area to another (e.g., walking, crawling, scooting, using bottomless car toys, scooters, bikes, push toys, or other toy vehicles). This also included locomoting with parental assistance (e.g. walking with parent's hands for support). Neither was scored when the child was stationary without any form of restraint.

The third item was dependent on the answer the caregiver chose for the previous question. If the caregiver answered "Restrained by device/furniture" they were asked "In what device/furniture is your child restrained in?" with answer choices being "Carseat", "Stroller", "Highchair/booster/other belted seat", "Bouncer/jumper/exersaucer", or "Other: write in". A picture grid was displayed along with the question for the caregiver's reference (See Figure 1). If the child was in a device not listed in the survey or the caregiver was not sure how to classify the device, they had the option of selecting "Other: write in" to describe the device that the child was restrained in to the best of their ability.

Figure 1. Example photo grid that includes the four types of device restraint measured: carseat, stroller, belted seat, and bouncer. The survey included a photo grid similar to this image for caregivers to reference when completing the related question.

If the caregiver answered "Restrained by caregiver" for the second question, they were asked "In what way is your child restrained by caregiver?" with answer choices being “Baby carrier in front”, “Baby carrier on back”, “Held on lap”, “Held in arms”, or “Other: write in”. Caregivers would select Held on lap if their child was held on their lap without the child using their own feet for support and movement was restricted. Held in arms was selected if the child was held in the caregiver’s arms but this category excluded supported walking, or any parental contact in which the child was capable of locomoting. Caregivers had the option of selecting Other if the type of restraint was not listed in the survey or they were not sure how to classify the type of restraint. A picture grid was displayed along with the question for the caregiver’s reference (See Figure 2).

Figure 2. Example photo grid that includes the four types of caregiver restraint measured: baby carrier in front, baby carrier on back, held on lap, and held in arms. The survey included a photo grid similar to this image for caregivers to reference when completing the related question.

If the caregiver answered “Locomoting” or “Neither” for the second question, they were asked “In what position is your child” with answers being “Upright”, “Sitting”, “Supine”, “Prone”, or “Other: write in”. Upright indicated infants were standing independently, standing while holding onto a caregiver of furniture for support, or walking. Sitting indicated a seated position with the back vertical to the ground and included independent sitting or sitting in infant or adult furniture. Supine was lying flat on the back. Prone counted any position with belly toward the ground, including lying face down, stationary while propped up on hands and knees/feet, and any type of crawling. A picture grid was displayed along with the question for the caregiver’s reference (See Figure 3).

Figure 3. Example photo grid that includes the four types of body positions measured: upright, sitting, supine, and prone. The survey included a photo grid similar to this image for caregivers to reference when completing the related question.

The fourth item asked "Who could your child interact with right now? (see, hear, play with, talk to)" with answers including "Just me", "Myself and one other person", or "Myself and two or more other people".

The fifth item asked caregivers to "Select the activity that your child is engaged in:" with answers including "Napping" (child is put down for a nap, but not yet sleeping), "Feeding", "Bathing/dressing" (includes bath time and grooming), "Reading", "Media Viewing" (includes iPads, phones, television, or any device with a screen), "Errands or transportation" (Out of the house, such as driving, going to a doctor's appointment or shopping in a store), "Play", or "Other: write in".

The sixth item asked, "Is your child holding an object?" with options being "Yes: write in" or "No". Caregivers were asked to write in the object that the child was holding if the object was carriable which excluded furniture and holding on to surfaces for support.

Between session phone call. A phone call after each session included a structured interview between the caregiver and experimenter that assessed the infant's motor milestones Adolph, Vereijken, and Shrout (2003) in addition to the collection of the following sessions available days and times. Caregivers reported whether infants could sit independently or with their hands for support (tripod sitting) for 30 sec without falling over, crawl on their belly and/or hands and knees for ten continuous feet across the floor, and walk unaided, without stopping or falling, for ten continuous feet across the floor. Caregivers reported the onset date of each skill that infants were able to perform. Caregivers completed a final motor milestones interview at the end of their 13-month session.

Exit questionnaire. After the fourth session at 13-months-old, caregivers completed an online version of the MacArthur-Bates Communicative Development Inventory, a language development assessment. This parental report assessed children's communicative understanding of vocabulary comprehension, production, and gestures. Caregivers also completed a brief demographics survey.

Results

The current analyses provides a preliminary aggregated report of completed 10 and 11 month old sessions. The data presented shows a consistent trend in the amount of time infants spent unrestrained and holding objects. Additionally, responses were monitored to determine the viability of the data collection techniques in capturing developmental change in infancy.

Survey Compliance

Each parent was asked to respond to 40 text message surveys per monthly session. Responses were collated at the conclusion of each monthly session. In addition to responses for each item, detailed logs of the survey allowed us to examine the time that text message surveys were sent out and to identify if parents responded before the survey expired. To determine the viability of this methodological approach, we first determined if caretakers were complying with directions to respond to the surveys. The overall compliance rate to the surveys was 88.88%. However, compliance does not necessarily mean that responses were reporting infant object interaction and restraint because parents could indicate that they were away from their infant or their infant was sleeping. From the surveys with valid responses, we examined the first item of the survey to determine the percentage of times that the parents were with their awake child, away from their child, or the child was sleeping. We calculated that 66.26% of responses reported infant behavior from an awake child. For the remaining responses, parents either indicated that their infant was sleeping (18.65%) or they were not with their child (3.96%).

Carrying Objects and Unrestrained Time

Aggregate parent reports indicate that 10-11 month old infants spent 58.08% of their waking day carrying objects, and 41.92% of their waking hours not holding objects. To determine if aggregate amounts are consistent across the infants' day, infant-object interaction was split into three 8-hour periods from 12:00AM to 12:00AM the following day: Morning, Mid-day, and Evening. Reports show that infants spent 59.92% of their time holding objects in the morning, 57.14% of their time holding objects in the middle of the day, and 57.28% of their time holding objects in the evening (See Figure 4). The aggregate parent reports for restraint indicates that 10-11 month old infants spent 47.31% of their waking hours unrestrained and 52.69% of their time restrained by a baby device or caregiver. Additionally, infants' time spent unrestrained was broken up over three 8 hour periods, with 49.82% of infants' time in the morning spent unrestrained, 47.73% of infants' time in the middle of the day unrestrained, and 42.11% of infants' time in the evening unrestrained (See Figure 5).

Discussion

This study measured object interaction and time spent unrestrained using a novel Ecological Momentary Assessment methodology to gain insight into the everyday experiences of infants'. The results show that 10- to 11-month-old infants interact with objects slightly more than half of the time they are awake. In the context of language learning, this would provide ample opportunity for caregivers to provide labels for objects. Our data also contains parent reports of which items were being held. Qualitative inspection of the data will allow us to see if reported objects align with common early words.

Our results also indicated that infants spend roughly half of their waking hours unrestrained. Simply being unrestrained is not necessarily all that is needed for high

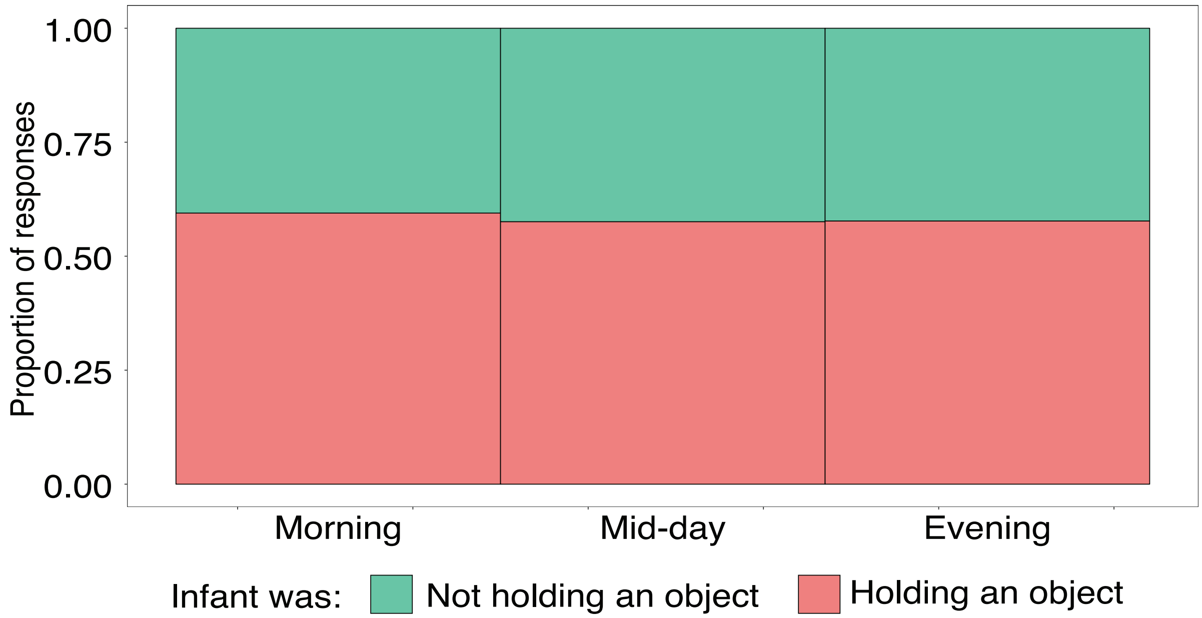

Figure 4. Aggregate parent reports show that 10-11 month old infants spent 58.08% of their waking hours holding objects: 59.92% in the morning, 57.14% in the middle of the day, and 57.28% in the evening.

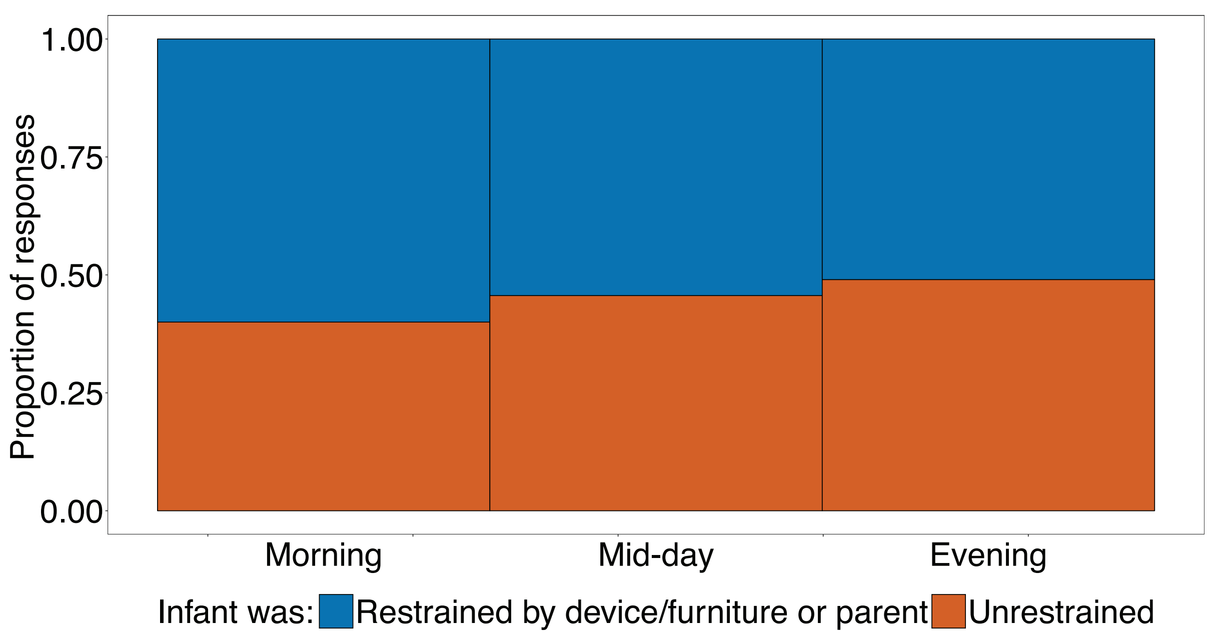

Figure 5. Aggregate parent reports show that 10-11 month old infants spent 47.31% of their waking hours unrestrained: 49.82% in the morning, 47.73% in the middle of the day, and 42.11% in the evening.

quality exploratory experiences that leads to language learning. But given the circumstance of the reported data, infants that were reported as unrestrained were necessarily with their parents nearby. While we are unable to know for certain, these conditions could potentially mean high quality face-to-face interactions with caregivers are occurring for about half of the infants' day. Preliminary checks of the data indicate that infant-object interaction and time spent unrestrained remains fairly consistent across all hours of the infants' waking day, with not much variation in proportion of responses between morning, mid-day, and evening. In other words, infants spent approximately the same amount of time holding objects and being unrestrained in the morning as they did throughout the rest of the day.

The current aggregate parent reports provide a starting point for understanding the developmental changes that occur at the end of the first year. However, further data collection will allow us to explore whether the developmental changes that arise from learning to walk promote language development. In addition to measuring object interaction and restraint, a motor milestones assessment after each session will give accurate accounts of the timeline in which infants achieve new motor milestones. A language assessment after the fourth and final session will also be administered in order to assess infants' language and communication skills. This information in conjunction with 12 and 13 months data on infant-object interaction and restraint will allow for analysis on how infants' daily experiences change following the acquisition of motor abilities. Further exploration will determine whether changes in these daily experiences as a result of motor ability acquisition will lead to language development.

Data collection is currently ongoing, projected to have a total of 50 participants for the completed 10-13 month sessions, with future analysis exploring the developmental changes that arise from object interaction and time spent restrained. Continued research will look at age related changes in object interaction and time spent unrestrained. We want to determine whether there is an increase in object interaction and time spent unrestrained at the end of the first year. At the completion of the 13 month session, we will look within subjects longitudinally to determine whether infant-object interaction and restraint changes following the onset of walking.

We predict that there will be a significant increase in object interaction and time spent unrestrained following onset of walking (Karasik et al., 2011). It is predicted that as infants begin to gain further autonomy of their bodies, their opportunities for exploration will increase. Whether this increase in exploration is the result of parents' trust in their infants' abilities (Keller et al., 2002), it is likely to lead to further interaction with objects. By comparing changes in object interaction and time spent unrestrained relative to when infants begin to walk, we can determine if walking plays a role in these behaviors above and beyond age-related changes. Additionally, a language assessment after the final session at 13 months will measure the relationship between vocabulary, object interaction, time spent unrestrained, and onset of walking ability.

Ultimately, we predict that object interaction and being unrestrained are two intermediate variables that follow onset of walking that are the important contributors to language development, rather than walking on its own. While there is a common misconception surrounding the idea that the use of devices enhances motor abilities, future data will likely aid in further understanding of whether use of these hinders or delays development (Abbott & Bartlett, 2001). These findings would help to situate these daily experiences in the link between walking and vocabulary development. In understanding the changes in infants' daily experiences at the end of the first year that promote language development, caregivers can more ably assist in this developmental change to provide appropriate learning experiences and facilitate exploratory behaviors.

References

Abbott, A., & Bartlett, D. (2001). Infant motor development and equipment use in the home. *Child: Care, Health and Development*, *27*, 295–306.

Adolph, K. E., Berger, S. E., & Leo, A. J. (2011). Developmental continuity? crawling, cruising, and walking. *Developmental Science*, *14*, 306–318.

Adolph, K. E., & Robinson, S. R. (2013). The road to walking: What learning to walk tells us about development. In P. Zelazo (Ed.), *Oxford handbook of developmental psychology* (p. 403-443). New York: Oxford University Press.

Adolph, K. E., Vereijken, B., & Shrout, P. E. (2003). What changes in infant walking and why. *Child Development*, *74*, 475–497.

Arslan, R. C., Walther, M. P., & Tata, C. S. (2020). formr: A study framework allowing for automated feedback generation and complex longitudinal experience-sampling studies using r. *Behavior Research Methods*, *52*, 376–387.

Bateson, M., Nettle, D., & Roberts, G. (2006). Cues of being watched enhance cooperation in a real-world setting. *Biology Letters*, *2*, 412–414.

Bushnell, E. W., & Boudreau, J. P. (1993). Motor development and the mind: The potential role of motor abilities as a determinant of aspects of perceptual development. *Child Development*, *64*, 1005–1021.

Crouchman, M. (1986). The effects of babywalkers on early locomotor development. *Developmental Medicine & Child Neurology*, *28*(6), 757–761.

Fay, D., Hall, M., Murray, M., Saatdjian, A., & Vohwinkel, E. (2006). The effect of infant exercise equipment on motor milestone achievement. *Pediatric physical therapy*, *18*(1), 90.

Franchak, J. M. (2019). Changing opportunities for learning in everyday life: Infant body position over the first year. *Infancy*, *24*, 187–209.

Gibson, E. J. (1988). Exploratory behavior in the development of perceiving, acting, and the acquiring of knowledge. *Annual Review of Psychology*, *39*, 1–42.

Karasik, L. B., Adolph, K. E., Tamis-LeMonda, C. S., & Zuckerman, A. L. (2012). Carry on: Spontaneous object carrying in 13-month-old crawling and walking infants. *Developmental Psychology*, *48*, 389.

Karasik, L. B., Tamis-LeMonda, C. S., & Adolph, K. E. (2011). Transition from crawling to walking and infants' actions with objects and people. *Child Development*, *82*, 1199–1209.

Keller, H., Yovsi, R. D., & Voelker, S. (2002). The role of motor stimulation in parental ethnotheories: The case of cameroonian nso and german women. *Journal of Cross-Cultural Psychology*, *33*, 398–414.

Kretch, K. S., Franchak, J. M., & Adolph, K. E. (2014). Crawling and walking infants see the world differently. *Child Development*, *85*, 1503–1518.

Libertus, K., & Violi, D. A. (2016). Sit to talk: relation between motor skills and language development in infancy. *Frontiers in Psychology*, *7*, 475.

Masten, A. S., & Cicchetti, D. (2010). Developmental cascades. *Development and Psychopathology*, *22*, 491–495.

Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annu. Rev. Clin. Psychol.*, *4*, 1–32.

Swingley, D. (2008). The roots of the early vocabulary in infants' learning from speech. *Current Directions in Psychological Science*, *17*, 308–312.

Walle, E. A., & Campos, J. J. (2014). Infant language development is related to the acquisition of walking. *Developmental Psychology*, *50*, 336.

Wright, C. M., Cameron, K., Tsiaka, M., & Parkinson, K. N. (2010). Is baby-led weaning feasible? when do babies first reach out for and eat finger foods? *Maternal Child Nutrition*, *7*, 27–33.