


Milestones or Millstones: How Standard Assessments Mask Cultural Variation and Misinform Policies Aimed at Early Childhood Development

Lana B. Karasik¹  and Scott R. Robinson²

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Abstract

Traditionally, the study of motor development—rooted in Western populations and culture—has focused on establishing norms in the timing and sequence of motor skills, inspiring the widely used emphasis on motor milestones in standard assessments (e.g., crawling by 8 months). Motor milestones are only a perceived version of what is an important skill; they are cultural conventions, not universals. Some cultures allow infants floor time; others carry them constantly, limiting practice. Thus, milestones create millstones to considerations of culture and context. Cultural beliefs, practices, and expectations manifest in childrearing practices. The variability in childrearing—or differences in infants’ experiences—offer unique opportunities for posture, balance, and locomotion, which in turn generates variation in motor skills both within and between cultures. Cross-cultural comparisons best illustrate the enormous variability in infants’ everyday experiences and effects on motor skills. We offer suggestions from this cross-cultural perspective to inform policy when designing interventions to help infants and young children thrive.

Keywords

cross-cultural comparisons, infant motor development, developmental assessments, motor milestones, parenting practices

Tweet

Milestones are inadequate conventions for charting early development. Based on Western standards, milestones ignore cultural variation in childrearing and environment. Policy should incorporate the cultural and ecological context in which children’s behavior occurs.

- Rather than holding a child’s development to an absolute standard, the child’s behavior should be considered within the context of the culture and ecology where it is expressed.

Key Points

- Motor milestones, a traditional way to assess motor development, emphasize motor skill acquisition but ignore culture and context.
- Culture guides caregivers’ expectations, beliefs, and childrearing practices that provide unique experiences for infants to shape their practice with manual action, posture, and locomotion.
- Effects of experience—timing, type, and extent—need further investigation to fully understand how and when experience is relevant for developmental outcomes.
- From a cross-cultural perspective, motor milestones are unreliable guides to policy as they offer false prescriptions of motor development, not full descriptions of it.

Introduction

The mother squats, the heels of her bare feet firmly planted on the floor beside the intricately carved “gahvora” cradle. She places her 20-month-old on his back atop the millet-stuffed mattress, which lines the shallow wooden base of the 90-cm long, 25-cm tall cradle. The baby’s bare bottom covers the hole in the mattress. A “tuvak” bowl, suspended beneath the hole, collects urine through a “sumak,” an external catheter carved from soft wood or molded in plastic specifically for girls or boys. While holding the catheter in place, the mother straightens the infant’s legs with her free hand and

¹Department of Psychology, College of Staten Island and Graduate Center, City University of New York, Staten Island, NY, USA

²Pacific Ethnological Laboratories, Olympia, WA, USA

Corresponding Author:

Lana B. Karasik, College of Staten Island and Graduate Center, City University of New York, Staten Island, NY 10314, USA.
Email: lana.karasik@csi.cuny.edu

swaddles them tightly, smoothing out wrinkles in the fabric. She reaches for wide, velour bindings and wraps them tightly around the already swaddled legs, fastening the strings to the gahvora's handle, which stretches from head to foot. The baby appears blithely unaware of all the handling, observes the surroundings of the narrow, tapestry-covered room, minimally furnished; the cement floor covered with thin, colorful rugs. While chatting with others in the room and directing her other children dillydallying about, the mother swaddles and binds the baby's arms and torso. The baby smiles in her direction, babbles, and she returns the overture. She places a blanket over the baby's body and drapes the entire gahvora with a thick cover, like a giant tea cozy, which will protect the baby from draft, daylight, and occasional insects. The cradling process takes merely 2 minutes. She hastily adjusts her embroidered headscarf as she draws the gahvora cover to reveal the baby's face; she bends over the cradle to begin breastfeeding. Once the baby is satiated, the mother grips the handle of the gahvora and rocks it vigorously while softly humming a lullaby. Within minutes the baby is asleep and will remain in the gahvora for hours, even after waking, unless fussing to be let out.

What does this typical daily childrearing routine in Tajikistan have to do with motor development? As developmental scientists in the U.S. studying motor skill acquisition in infants and animals, we were intrigued. Much of what we know about motor development comes from studies of infants reared in Western traditions, which emphasize freedom to move. Accounts of childrearing practices around the globe also seem to stand in sharp contrast to gahvora cradling (Adolph et al., 2010; Karasik, 2018; Ulziibat et al., 2021). In cultures where caregivers use swaddling cloths, cradleboards, "manta pouches" and the like, their use is limited to only the first few months of life and to times of day when infants are asleep. However, in Tajikistan and other parts of Central Asia, Middle East, and North Africa (Bloch, 1966; Epstein, 1981) caregivers have used a traditional "gahvora" cradle for generations. The gahvora tradition shares many characteristics with other restrictive childrearing practices, but its use is not limited to sleeping newborns. A total of 12- to 24-month-olds can spend 15 hours or more in the gahvora each day, through sleep and waking, without leaving the cradle (Karasik et al., 2018).

Gahvora cradling is just one example of the diversity of childrearing practices commonly used in cultures around the world. Motor skills emerge in the context of such practices. Largely unfamiliar to most Western scientists, childrearing practices in other cultures provide a much richer picture of the formative role of experience in motor development and how it can inform policy when the population across the United States is becoming ethnically and culturally more diverse. Children raised in different cultural contexts can reveal individual variability in how skills emerge during early development. Importantly, the course of

development of these children exposes the context—physical environment and caregivers' behavior—in which motor skills unfold and improve.

The concept of developmental milestones is familiar to Western practitioners and parents alike. Milestones provide a convenient way to gauge changes in discrete motor skills, their order of appearance, and the age at acquisition. Charting the achievement of developmental milestones is a practice firmly embedded in Western traditions of developmental science, so it was only natural that we began our venture into Tajikistan to study gahvora cradling and infant development with a focus on milestones. Because Tajik infants are immobilized in the gahvora for many hours a day over many months, we expected they would show delays in the achievement of certain milestones relative to Western established norms. However, the course of child development is not accurately reflected in a milestone chart in a parent's magazine. Although Tajik children are indeed delayed in key motor skills, they show no long-term deficits. The role of free movement in early motor development appears to be more nuanced and non-linear than originally conceived. This fascinating window into another culture continues to spark new questions about the effects and timing of early experience.

Culture Guides Childrearing Practices

Much of cross-cultural research on motor development is dominated by comparisons of age norms and developmental scales established with populations following Western childrearing practices. Researchers have compared infants in Africa, Central and South America, and Asia on well-established developmental scales with the principal aim of identifying whether onset ages of milestone skills are accelerated or delayed. In some African and Caribbean cultures, infants sit and walk earlier than reported on standard assessments (Hopkins & Westra, 1990; Super, 1976). Ache infants of Eastern Paraguay begin to walk nine months later than specified on standard assessments and a full year later than some African children (Kaplan & Dove, 1987). Infants in northern China are delayed by weeks to months in sitting and walking (Mei, 1994). These differences are not due to genetic heritage; populations derived from the same ethnic and national origins living in Western countries more closely match Western norms, suggesting that variation in onset ages can be traced to differences in childrearing practices (Mayson et al., 2009; Nelson et al., 2004; Super, 1976).

In some cultures, caregivers use vigorous approaches to handling. Intense massage, daily exercise, and close body contact are common practices documented across Africa in communities such as Kipsigis and !Kung San (Konner, 1976), the Gusii (LeVine & LeVine, 1966), the Bambara (Bril & Sabatier, 1986), Nso (Carra et al., 2014; Keller et al., 2002), and African-derived populations in the West Indies (Hopkins & Westra, 1988). During bathing routines,

caregivers give infants a rubdown, kneading the head and body, rotating the joints, and pumping the legs and arms. They toss infants into the air, suspend them by the neck or from the ankles, and grasp them by each limb. Caregivers in these cultural communities believe that tight muscles and joints at birth should be stretched and massaged (Rabain-Jamin & Wornham, 1993), thereby increasing the range of motion and expanding opportunities for spontaneous movement.

Caregivers' expectations about handling routines inform childrearing. That is, caregivers, express beliefs about what they should be doing as part of everyday interactions to ensure healthy development (Carra et al., 2013). Childrearing beliefs can be so ardent that when caregivers emigrate, they often maintain or modify traditional practices rather than adopting Western habits (Bornstein et al., 2020). For instance, some West African immigrants living in Italy and France, Jamaican mothers living in Britain, and rural Kenyan mothers living in Nairobi continue to apply frequent body stimulation and exercise routines (Carra, et al., 2013; Hopkins & Westra, 1990; Rabain-Jamin & Wornham, 1993).

Passive effects of childrearing also can affect motor development. Caregivers inadvertently shape opportunities for movement and exploration by arranging infants' physical space. Different cultures display a variety of ways of containing or transporting infants. Gahvora use in Tajikistan creates obvious limitations in the environment accessible to infants. Slings or sacks tied to caregivers' bodies are used to tote infants in parts of East and West Africa, Central and South America, and Papua New Guinea (Bril & Sabatier, 1986; Kaplan & Dove, 1987; LeVine & LeVine, 1966; Solomons & Solomons, 1975; Tracer, 2009). Zinacanteco infants of a Mayan community in Mexico are carried on their mother's back in a "rebozo" shawl that is wrapped around the infant and knotted over the mothers' chest. During the first year, infants are seldom held upright and are not free to look around; their face remains covered in the rebozo (Brazelton et al., 1969). Among the Ache of Paraguay, infants are carried and rarely set down or left alone (Hill & Hurtado, 1996). Caregivers actively discourage exploration to protect children from hazards. Mothers tie a vine around the ankle to prevent children from wandering into the fire. When camp is moved, infants are carried in a sling with their heads resting on mothers' chests. At 18 months, children are not yet walking and are taught to ride on their mother's carrying basket, holding on while ducking branches and vines. Later in childhood, however, Ache children are encouraged to move and explore, walking 3–5 km over difficult forest terrain when camp is moved and climbing 25-meter trees to play or forage (Hill & Hurtado, 1996; Kaplan & Dove, 1987).

The physical settings in which motor skills emerge are meaningful. For example, both adults and infants choose the place and manner of sitting based on the physical and cultural environment (Bril, 2018; Hewes, 1955). In typical

Western homes, adults sit on chairs, couches, benches, or other raised surfaces. In other cultures, sitting takes place on the floor and takes many forms (e.g., squatting, kneeling, side sit or long sit, cross-legged). For infants, Western caregivers typically strap infants to car seats or bouncers, perhaps with an expectation about infants' lack of skill or simply cultural mores of never leaving an infant unattended. But mothers from Kenya or Cameroon spent considerable time out of their sitting infants' reach (Karasik et al., 2015), expecting them to keep balance on their own.

Normative Development is Neither Normal nor Developmental

As the examples above attest, childrearing and the environments in which children's motor skills develop are incredibly diverse around the world. Yet developmental psychologists are more accustomed to appreciating environmental context in social and cognitive development than in the motor domain. Motor development is traditionally viewed as biologically driven, a process of simple maturation studied with a focus on timing and sequence of key skills. The ages when independent sitting, crawling, and walking first appear are considered both predictive and prescriptive, with delays suggesting the potential need for intervention.

The milestone approach stems from work in the first half of the 20th century by early pioneers in the study of motor development, notably including Arnold Gesell. If motor development is simply the product of neurological maturation and physical growth—a view that was dominant then and prominent today—then developmental scientists needed only to identify the normal pattern of progress. Gesell acknowledged the historical and cultural shifts that could underlie variability in motor skills (Gesell & Ilg, 1943). But because his focus was on establishing commonalities in infants' skills, he relied on a homogenous sample of infants (from middle-class, two-parent families of European descent living in New Haven, CT) to identify ages of skill onset. Parallel efforts to codify motor milestones have been applied to animal development with the same goal: to chart normal neural development as revealed by motor behavior (Altman & Sudarshan, 1975). The profound influence of the maturationist view is still represented in conventional charts of motor milestones used in clinical training and scales of infant and child development, which are normed against Western European standards.

The World Health Organization (WHO) recently updated standards—requirements for the sequence and timing of infant postural and locomotor milestones—that all infants should meet (Martorell et al., 2006). The WHO acknowledged greater diversity by including infants from six countries—Brazil, Ghana, India, Norway, Oman, and the United States of America—thus expanding variability in onset ages of predetermined skills. The selection of skills in the

revised standards, however, are still based on Western norms, while sources of variability, such as context (i.e., childrearing, physical environment, etc.) are not addressed.

Norms and standards may be useful for clinical diagnostics, but they oversimplify motor development by emphasizing *when* skills should emerge rather than *how*. Three problems stem from this conception of development (Berger et al., 2021). First, specifying typical (“normal”) development without context is meaningless. Infants develop manual skills by reaching, grasping, and exploring objects in their environment; they devise effective ways to locomote afforded by the surfaces in their physical space. Change the space and you change development.

Second, the focus on group averages overlooks enormous variability between individuals. Although variability on charts may be acknowledged, it is generally unstudied (and unquestioned) as to why some kids begin to reach, sit, or walk earlier or later than others.

Third, identifying when a new skill first appears is not a trivial problem. Most skills such as sitting, reaching, or walking without support, do not simply appear one day and continue to be expressed every day thereafter. Emerging behavior sputters in and out on a daily basis. In contrast to Western parents who are sensitized to milestone charts, parents in other cultures provide poor retrospective records of skill performance, and researchers rarely observe often enough to accurately capture dates of skill onset (Adolph et al., 2008a). Different parental expectations and childrearing practices thus can markedly affect appraisal of standardized skills, (Keller, 2007), but rarely are childrearing practices or infants’ everyday experiences studied systematically or documented in routine motor assessments.

Infants’ experiences created by childrearing practices should be considered seriously, as these provide the context in which skills develop. Children developing in other cultures highlight the social and contextual influences on motor development, providing unique insight into the formative role of experience.

Avoid Dichotomous Thinking: Experience is on a Continuum

Comparing cultures that engage in a particular practice (typically non-Western) to those that do not (Western) can perpetuate a misconception that experience is a dichotomy—infants are exercised or not, carried or not, swaddled or not. Treating childrearing as a binary choice implies that practices either promote or hinder behaviors. But childrearing practices are continuous, not discrete, in their use and their effects. Sling carrying, for example, is restrictive because infants’ opportunities to roam and explore their environment are impeded. But some aspects of posture and balance may be facilitated as infants adjust to the mother bending and moving (reviewed in Bril, 2018). Moreover, sling carrying

may be related to advanced motor behavior at 6 months but not at 12 months (Goldberg, 1972), possibly because infants are experiencing rapid change in different skills at these two ages. Thus, although self-generated movement and exploration is limited, being passively carried may have its benefits: Infants get a wider view of the environment, cover more ground faster, and take an active view of the world while toted, learning about the dynamic nature of people and their interactions within the environment (Kretch & Adolph, 2015).

In contrast to many examples of children raised in other cultures, Western caregivers might seem to avoid restriction and foster movement and exploration. Yet there are many containments in common use in the United States in which infants spend time during the day. Highchairs and bouncers, like gahvoras and slings, place different constraints on posture, body, and limbs. On average, 12-month-olds in the United States spent time in seven containments and five accumulated hours in restricted settings distributed over their waking day as compared to only two containments and two accumulated hours for Tajik 12-month-olds (Karasik et al., 2021).

Moreover, containment during infancy is not all bad. Swaddling restricts movement but apparently has beneficial effects on self-regulation (Donmez & Temel, 2019). Locomotion is thwarted in a highchair, but manual action and play are heightened—seated infants play with food and utensils and pretend-play to feed a dolly or mom. In similar ways, the gahvora restricts movement and vision but appears not to impair social interaction. As we observed, an infant in a gahvora often attracts the attention of older siblings, providing opportunities for social interaction when the cradle-bound child is awake. When restricted in caregivers’ arms during handling and massaging, mothers from West Africa also engage in positive social exchanges (Carra et al., 2014). The use of slings, carriers, strollers, or even a gahvora cradle thus can restrict self-generated movement while enhancing experience in other domains, such as attention, manual actions, visual experience, and social interaction.

Containments can restrict movement, but only while in use. Once a child is removed from containment, they are free to engage in varied, distributed practice moving, exploring, and interacting. In Tajikistan, gahvora use varied widely from family to family and region to region. Some mothers ceased using a gahvora after 24 months and some continued for three years. Some infants spent nearly a full 24-h day in the gahvora while others were cradled for only an hour or two. Gahvora cradling also appears to result in no long-term effects, regardless of the amount of use. It seems likely that children benefit from variable motor practice once gahvora cradling stops. Indeed, practice is a stronger predictor of motor proficiency than chronological age (Adolph et al., 2003).

One way of extending the study of children’s motor skills beyond standard assessments is by exploring ecologically-relevant everyday behaviors. In Tajikistan,

during research visits of 2- to 3-hours, children engaged in everyday routines inside and outside the home. Children roamed freely around the neighboring community of homes, from house to house, expertly navigating a variety of surfaces and elevations. Access to a richly varied environment required children to flexibly adjust their motor behaviors to navigate a variety of spaces and places. Culturally relevant experiences hone children's skills that are appropriate for their environment. Who is to say that Western children aren't delayed relative to Tajik children riding donkeys or Ache children climbing trees?

New Technologies Provide New Insights

The study of motor development has advanced significantly with improved methodologies. Recording and scoring behavior from a video has proven especially impactful for describing and quantifying movement. The richness of information captured by video offers similar promise in the study of experience. Motor development is profoundly affected by experience. This simple fact has long been appreciated by developmental researchers. However, most studies have focused on experience *after* skill onset, not experience leading up to skill onset.

For example, the amount of motor experience after onset of a skill has been estimated by meticulously counting steps of infants who have recently begun to walk and those who have been walking for months (Adolph et al., 2012), and documenting every plaything encountered in infants who have been grasping objects for months (Herzberg et al., 2021). Only recently have new technologies begun to capture infants' everyday experience and practice leading up to skill onset (Franchak, 2019; Franchak et al., 2021; Rosales et al., 2021). Clever experimental designs have recently documented how enhanced practice leads to earlier expression of a skill (Adolph & Hoch, 2019 for review) and may effect changes in other developing domains such as communication (Karasik et al., 2014; Libertus et al., 2016; Walle & Campos, 2014). Much remains to be explored, however, such as how much and what kind of motor experience caregivers provide and when that experience is important.

When is experience relevant to motor development? Must experience occur within the developmental window when a skill typically emerges or is earlier experience potentially important? Well before the onset of walking, caregivers in Kokwet, a farming community in Western Kenya, support infants upright in their laps, encouraging them to take alternating steps shortly after birth (Super, 1976). At around 5 months, caregivers teach sitting by placing infants in a hole on the ground surrounded by cloths for support. Infants are found to spend 60% of their time sitting on caregivers as they resume daily activities. At 7 months infants are held under the arms with feet on the ground to encourage forward movement. Mothers in the West Indies, like Kenyan and Nigerian caregivers, encourage sitting (girls at

3 months; boys at 4 months) and stepping in caregivers' lap and on the floor (Hopkins & Westra, 1988, 1990). In each of these cultures, infants begin independent walking at earlier ages than in most Western societies. Although caregivers in the United States also frequently "walk" infants around the house by supporting them under the arms or holding them by the hands, such facilitation happens around 11 months (Karasik & Zuckerman, 2021), within the developmental window of walk onset.

Just how malleable is motor development? Cross-cultural studies have documented babies that are massaged, exercised, "rough-handled," and trained have skills that emerge earlier relative to Western norms. Although onset ages can vary widely, the developmental window of any skill is limited. Despite any amount of handling, stretching, and training, no baby walks at 5 months. That is doubtlessly adaptive. A 5-month-old walker will not have the cognitive, social, and linguistic competencies to adaptively navigate the environment and respond to social information, such as to stay put at the top of the stairs when mom warns "stop" (Adolph et al., 2008b; Karasik et al., 2008). Infants that receive such attention well before the developmental window cannot yet maintain balance, take independent steps, or sit without support. The fact that early handling can affect later development makes it difficult to disentangle specific effects of experience. What aspect of these early routines is most important for later motor skill development? When must these experiences happen to influence development?

The Western practice of swaddling illustrates how difficult it can be to determine the effects of movement restriction. Swaddling limits infants' activity and posture, yet results in no short or long-term effects on conventional motor milestones (Chisholm, 1978). Swaddling calms infants and improves their ability to soothe themselves after crying (Donmez & Temel, 2019; van Sleuwen et al., 2007). Self-soothing behaviors are important for information processing (Bornstein & Suess, 2000), but does not affect learning to handle objects (Lejeune et al., 2021). Swaddling of neonates may actually promote sleeping without interfering with the fine movements that accompany active sleep. Spontaneous twitching movement during active sleep refines neural circuitry and helps to construct sensory-motor reflexes in neonates (Del Rio-Bermudez & Blumberg, 2018). When older infants begin to acquire basic motor skills, swaddling is reduced, permitting more active movement (Nelson, 2017). At the transition to new motor skills, movement during sleep is ubiquitous and may become necessary for learning and consolidation (Berger & Moore, 2021; DeMasi & Berger, 2021).

Cultural Considerations for Policy

Standard assessments may identify delays or precocities, but they are notoriously unsympathetic to cultural variation. More so, standard assessments fail to explain, or even

adequately characterize, variability in infant motor outcomes. At best, standard assessments based on Western norms provide a label (often: ‘delayed’). There is a general lack of appreciation that an obtained score on an assessment only captures a moment in time, at a given age. The label, which is only strengthened by our reliance on motor milestones, may last much longer. Studies of motor development typically relate behavioral changes to age, but age is not the cause of behavior development. At best, age is a correlate of a changing neuromotor system and a stand-in for accrued experience. Instead of relying simply on age, the single factor emphasized by all milestones, the experiences of infants created by childrearing practices are a better indicator of what skills develop and how. Longitudinally, standard scores may fluctuate within an infant and look similar or diverge against other populations over time (Boonzaaijer et al., 2020).

Given the limitations of standard assessments, three considerations for policy are offered. First, policy must rethink the focus on milestones. Motor milestones are millstones to a “whole-child” approach to development—considering child development across developmental domains and within specific environments. Motor milestones focus only on the timing when skills appear but fail to identify which skills may be important and how skills emerge in a developmental context. For example, “log-rolling,” in which infants continually roll from supine to prone to get from place to place, was a particularly prevalent form of locomotion prior to walking in U.S. infants in the 1900s. At that time, nearly all babies wore long gowns, heavily starched, with hems reaching far beyond the feet making it difficult to crawl on hands and knees (Monet, 2021; Trettien, 1900). Similarly, “bum-shuffling,” scooting in a sitting position using feet and sometimes hands to push forward, has always been observed in infants across cultures. Log-rolling and bum-shuffling are not included as relevant skills on milestone charts.

A second consideration is that parents matter—an unsurprising statement given the evidence for the impact of childrearing practices. Parents’ expectations inform how infants should be handled, where they should be placed, and how much agency they should be allowed in their daily lives. Moreover, parents have culture-specific expectations about what skills infants should acquire and when and adjust their practices to meet those expectations (Gomes et al., 2017; Oudgenoeg-Paz et al., 2020). It is in the context of these handling practices caregivers evaluate the health and wellbeing of their babies and whether they are developing according to their cultural expectations. Thus, parents are important vehicles for interventions, as they will oversee compliance and follow-up. Mothers may fear that their culturally relevant practices can be viewed as inappropriate (e.g., Hopkins & Westra, 1988). If parents have different expectations and different definitions of skill onset and proficiency, they might be less likely to investigate services or comply with recommendations.

Finally, policy should consider motor development both *in* and *as* a context (Adolph & Hoch, 2019). Motor development in context means that culture—with its childrearing practices and parental expectations—shapes which skills are acquired, when, and to what extent. The social and physical context offer opportunities for practicing manual, postural, and locomotor behaviors.

Motor development as a context emphasizes that emerging motor skills interact with simultaneous changes in other developmental domains, creating new opportunities for development. Changes in posture, manual behavior, and locomotion allow infants to see more, do more, and interact more (Adolph & Tamis-LeMonda, 2014). Rather than focusing only on onset ages, researchers might be better served by a functional approach to motor development. In addition to moving limbs, maintaining posture, and propelling the body through space, motor development also entails directing gaze to objects and events, reaching for goals, gesturing to initiate social exchanges, bringing things across the room, and initiating play with others. A cultural and contextual approach to motor development could better serve infants, children, and their parents who guide them to be healthy and productive members of their community.


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ORCID iD

Lana B. Karasik  <https://orcid.org/0000-0003-0764-4557>

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