

What Developmental Science Has to Say About Caregiving

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There are numerous popular books, magazines, blogs, and websites that provide advice or anecdotes about how best to care for children. These sources of information can drown out conclusions based on scientific consensus, negatively influencing the behavior of parents and other caregivers and impacting societal action and policies implemented to support children and families. Scientific research in child development, psychology, and neuroscience provides valuable insights into key aspects of caring for children that not only can enhance the likelihood of positive outcomes for children but can also empower parents, childcare providers, and communities with the knowledge and confidence needed to make informed decisions about their children's upbringing. These data can also inform public policies that can increase access and reduce barriers to quality environments for all children. Here, we highlight reliable findings about biobehavioral development that can bear upon policies and practices for supporting healthy child development.

There are many research findings that bear upon the caregiving of infants and young children. Highlighting data that have been highly consistent, replicable, and reliable, we have organized these scientific findings in terms of three general themes: the importance of the timing in which children are exposed to certain experiences, the critical role of predictability and consistency in children's lives, and the significance of social support and children's perceptions of safety. Common across these themes is the important recognition that even infants and very young children are powerful learners, and that what they experience is a central aspect of human brain growth and organization. In addition, we present conclusions that appear to be consistent across cultures, nationalities, and demographic subgroups. There are many factors that affect child development; our aim is to present research that addresses issues that are relevant to the decisions of individual caregivers, rather than broader structural issues, such as public policies surrounding health care, nutrition, and education, that require societal or political change. Of note, these empirically based ideas can and should inform public policies to increase the quality of environments in which children develop. We will note when broader structural issues impede the capac-

ity of caregivers to create the type of environments developmental science has found to be optimal for young children.

Before discussing what developmental science tells us about how to structure caregiving in the service of healthy brain development, we must note that culture and societal norms influence caregiving and thus the timing and pattern of young children's experiences. Cultures can differ markedly in how the caregiving of young children is done. In some cultures, children are breastfed for much longer than in others. Some cultures encourage infants to crawl and explore their environment as early as possible, whereas in others it is viewed as unhealthy to have infants on the floor or ground. Some cultures prioritize adult one-on-one interactions with infants and young children, whereas in other cultures children learn by spending a good deal of time observing adults interacting with one another and going about their everyday chores. Regrettably, the vast majority of research on children's experiences and their brain development has been conducted in upper-income countries with children whose parents have generally received many years of formal education. There is a growing literature, however, on children in low- and middle-income countries in families with less education, which is beginning to complement and enrich understanding of critical experiences for healthy development. There is also an emerging literature on how seemingly adverse early environments may lead to the development of "hidden talents" or adaptations that allow individuals to thrive under less-than-optimal circumstances.¹ The hidden-talent literature is still in a nascent state, with more work needed before any potential scientific consensus on the nature of these talents and the conditions that support their development. Thus, while we lay out the evidence about caregiving that scientists have accumulated, we also recognize that there is a tremendous wealth of knowledge to be gained from studies that are more inclusive about the variety and range of caregiving practices around the world. Culture not only influences how parents and children behave but also what scientists will choose to notice about parent-child interactions.

One set of questions about caregiving involves the best times to introduce children to different types of experiences. Developmental timing refers to two sides of the same coin. On one side are time spans when a child is exceptionally receptive to and ready for certain types of environmental experiences. On the other side are times when either children are not ready for experiences and may be overwhelmed or unresponsive to those inputs, or the experiences occur too late, slowing the emergence of other skills needed for optimal development. Caregivers make decisions about when to expose children to new foods, people, activities, additional languages, opportunities to build motor skills, emotional and interpersonal situations, media, independence, information about the world, germs, and other potential risks and opportunities. In making these decisions, caregiving entails making an assessment about the extent to which a child is ready to absorb

and integrate pertinent skills, and whether a new experience is appropriate for a child's developmental phases.

Sometimes these matches and mismatches seem obvious and easy to tie to a child's chronological age. It would be foolish to give solid food to a newborn or expect a three-year-old to stay safe alone without supervision. In other situations, there are guidelines that operate consistently across individuals, though caregivers may not be aware of the science informing the issue. For example, adults often try to keep newborn infants clean, with at least lay recognition that the immune system at birth is just starting out and newborns are vulnerable to illness. But perhaps less obvious is that the immune system is a learning system and needs stimulation in order to optimally develop. New research is showing that the immune system benefits from exposure to biodiversity found in the natural environment of soil and plants and animals.² So it actually is helpful to immune health for young children to be exposed to pets in their home and allowed to indulge in one of their favorite pastimes – playing in the mud!

Bilingualism is another example. How best to treat children growing up in homes where they do not speak the language of the majority? Will they learn better if we teach them only in the dominant culture language? And what about families in which two languages are spoken? Will language development be hampered by being exposed to two languages early in development?

There is a tremendous amount of misinformation about the benefits and timing of exposing children to multiple languages in their everyday lives. Other than the cases of neurological disorders, exposing infants to multiple languages at the same time does not confuse them (even when the same caregivers switch frequently between using different languages). Even when children mix words from different languages, this is a normal part of language development. Indeed, very young multilingual children match their monolingual peers in conversational abilities and language-learning abilities.³ But the main point is that the science is completely clear about bilingual language exposure: earlier is better and more language as early as possible is the best. This is a function of both biology and social experience. Human brains are more receptive to language learning earlier in life, and in many cultures, adults speak and interact with infants and young children in ways that make language learning easier and engaging. The earlier a child is exposed to multiple languages, the more likely the child is to attain fluency, have a richer vocabulary, use standard grammar, speak and understand the languages quickly, and have full access into the cultures associated with those languages.⁴

While a child's body and brain are immature at birth, their healthy development depends on their interaction with the environment: what they experience, how they experience it, and, critically for some

aspects of development, when the experiences occur. A useful way of thinking about children's experiences is the distinction between "experience-expectant" and "experience-dependent" aspects of brain development. Experience-expectant aspects of brain development are those that caregivers of children with normally functioning sensory systems do not need to worry about. These are forms of stimulation that the developing brain expects and is ready to receive, and that naturally occur in nearly all environments. Think of things like patterns of light and sound, or surfaces with different depths, like stairs, holes in the ground, or cups and bowls. However, there are times when we need to make decisions about the timing of these experiences for children.

When children have vision, hearing, or motor issues, there is a need to decide about the optimal timing of experiences. Fortunately, there is solid data to inform those choices. As an example, when children are D/deaf or hard of hearing, we now know that they will benefit from exposure to gestural languages (such as American Sign Language or Spanish Sign Language) as early as possible, even as early as the first few months of life. D/deaf children of hearing parents quickly develop age-level vocabularies if they are exposed to gestural languages.⁵ These languages provide children with the same rich grammatical and semantic structures as do spoken languages. Access to these languages will not impair children's learning of other languages. In fact, exposure to sign language (even after cochlear implantation) increases language and cognitive skills in D/deaf children.⁶ And while we know little about how the quality of sound from devices like cochlear implants compares to spoken language, gestural languages provide known natural, high-quality language to children. Of course, gestural languages also offer important social opportunities, such as access to Deaf cultures. But again, the main point is that early access to gestural language is critical for normative brain development.⁷

Similar findings emerge from areas such as speech/language and physical/occupational therapies, where the vast preponderance of evidence suggests that the earlier the exposure a child has to these interventions, the better their outcomes. Of course, this intersects with issues of public policy, as the availability of these resources and capacity to access them are not equally distributed in the population logistically (for instance, urban versus rural access) or financially.

Experience-dependent processes are those that the human brain is able to learn, but when and how this learning occurs depend upon what and when the child is exposed or taught. For example, the brain expects to learn a language, but what that language is – Mandarin, American Sign Language, Swahili, Hindi, Ewe – depends upon the language that the child experiences. But, again, timing of exposure matters and appears to help configure the brain for future learning and development. Toward the end of children's first year of life, they begin to narrow the information that they take in from the world, such as faces and speech sounds.

During these months, humans begin to become experts in and gravitate toward characteristics of their own social group.

Around eight months of age, children begin to become wary of people, especially adults, that they do not know, sometimes showing fear when approached by an adult who is not familiar – even when that is their grandparent who has come to visit but who they haven't seen for many months! This is also when infants begin to lose the capacity to differentiate sounds that are not a part of the language(s) to which they are exposed. Infants enter the world with the ability to hear all the sounds produced by all languages of the world, but by twelve months of age, they will begin to lose the ability to hear the distinctions of speech sounds that they do not encounter in their everyday lives.⁸ Remarkably, six-month-old babies are as good at telling one monkey face from another as they are telling one human face from another. But by twelve months old, they can tell human faces apart, but not the faces of different monkeys of the same species. The same happens for recognition of people of different races, though not as profoundly. This narrowing of perceptual abilities – in language, face-processing, and social acceptance – is based upon the experiences that infants encounter in their lives. Babies exposed to different monkey faces remain good at telling monkeys apart; children exposed to different languages remain good at hearing the sounds of those languages; children exposed to people of different races and ethnicities excel at recognizing individuals across those groups.⁹ Children with a wider range of social experiences are more comfortable with new people, although they still clearly know who is familiar and who is new. There is even now evidence that by two years of age, children use information about who is like them and who is not to decide who to learn from.¹⁰ Because there are significant differences in how people express their thoughts and emotions across cultures, children who become adept at adjusting to these differences will engage with other people more successfully.¹¹ In a multicultural society, the earlier we expose children to the variety of people in their society, the better children should be at functioning beyond their homes and familiar communities.

Early childhood is also a time when children's bodies become conditioned to the degree of stress they must manage. Environments range in the physical and emotional demands they place on the people living in them. Human environments can vary on multiple dimensions: there may be extreme temperatures, the food supply can swing between feast and famine, and the number of pathogens an infant encounters can be very high or relatively low. Stress-reactive biological systems become calibrated early in life based upon the child's experiences. While the response of these systems helps to preserve life, they are metabolically costly, forming a tradeoff with wear and tear on the body. Early life is a sensitive period for establishing the set points for stress-responsive systems. The experimental evidence comes from work with animals showing that maternal interactions can actually change the regulation of the infant's genes that turn the activity of the stress

system on and off.¹² At this point, we do not know how much difference there needs to be in the harshness of the environment to result in changes in the set point of stress-responsive systems. In rodents, offspring of mothers who provide low care had higher stress-reactive systems than offspring of mothers providing very high care. But “care” in rodents is not the same as care of human infants.

In humans, there is evidence that markedly deprived care, such as experienced in orphanage-like situations, calibrates the stress system differently than care in family-like contexts. But beyond such extremes, there is no evidence in humans that brief separations, such as when children go to childcare, have long-term consequences for stress reactivity and regulation if the childcare is good. These periods of sensitivity to input can be helpful for guiding decisions about certain experiences that might have the greatest impact on children’s development.

Human brains have a remarkable ability to detect statistical regularities. Indeed, there is now evidence that the brain needs these regularities to build its circuits. For this reason, the predictability of their environments and of the responses of caregivers plays a critical role in children’s development.¹³ Children are sensitive to the statistical regularities that exist at many levels, from the probability that one sound in a language will follow another, to the probability that one caregiver action such as talking or touching will follow another. These patterns also include regularities that children come to expect in their lives, such as expecting that an evening routine will entail dinner, a bath, story time, and then bedtime. Even very young infants detect these patterns and use them to form expectations about what will happen next, and react when their expectations are violated. Infants also use their incorrect predictions to fine-tune and expand their learning.¹⁴ The importance of predictability explains why children thrive in stability and, conversely, why chaos and lack of stability are harmful for children’s development.¹⁵

Some aspects of creating predictable environments for children are relatively easy to ensure. We do not need to worry about making speech predictable; we only need to verbally engage with an infant, and the infant’s brain will calculate the statistics of how a language works.¹⁶ But we do need to deliberately ensure infants and young children experience routines and that their lives are as consistent and reliable as possible. This might involve regular mealtimes, expected bedtimes, consistent rules and discipline practices, and removing the barriers that make it hard for some families (such as shift work or just-in-time scheduling) to establish stability in the home. Creating predictable environments also means supporting the emotional health of those caring for young children, as mood swings among care providers can reduce predictability and stability of care. Frequent moves, changes in childcare arrangements, and, for foster children, moves between foster homes also create unstable, unpredictable environments. Perhaps

most salient to children is caregiver reliability. Do caregivers deliver on promises? Are they punctual for pick-up times? If a child is frightened, can the caregiver be counted on to respond in a comforting way? While the importance of routines has long been emphasized in advice to caregivers, we now know that predictability is so critical to brain development that its effects can be seen even when other important characteristics of care, such as sensitivity and a positive regard for the child, have been controlled statistically.¹⁷ In predictable environments, children are able to develop better regulation of thoughts, actions, and emotions, and that in turn affects an individual's academic success and later occupational and physical wellness.¹⁸

Lack of predictability in the environment has two effects. First, chaotic or irregular environments make it more difficult for children to learn patterns in their lives and in other people's behaviors. These patterns are the basis for a range of critical developmental skills that include communicating through language and emotion, and understanding how to engage and interact with others.¹⁹ Second, unpredictability leads children to perceive their lives as uncertain or volatile, resulting in feelings of anxiety that extend activation of stress response systems, as well as making decisions based upon seeing the world as an unstable place.²⁰ This extended activation alters brain architecture in regions such as the prefrontal cortex, amygdala, and hippocampus, which undermines adaptive regulation and coping.²¹ In contrast, relationships that are stereotypically repetitive, highly predictable, and marked by contingent responses – such as responding when an infant cries, comforting a child who is hurt, and providing support to a child who is distressed – foster healthy development of prefrontal-amygdala-hippocampal systems that help support well-regulated behaviors.²² Of course, children do need to learn that they can handle some changes in routine, so when routines have to be upset, the child isn't completely thrown for a loop. However, planning matters in making both little and even big transitions more manageable for children. Notably, in studies of children in foster care, transitions from one home to another or back to the parent's care produce less behavior disruption and physiological stress when there is careful preparation for the placement change.²³

Of course, as mentioned, to maintain a predictable pattern at home, those who care for children must have predictable work schedules, affordable childcare, and wages that allow them to provide for a child's needs. This aspect of caregiving is undermined when employers call employees to work and send them home on short notice, widely known as just-in-time scheduling. Low-income workers and single parents are more likely to work jobs with irregular schedules, making it difficult for them to create predictable daily life for their children.²⁴ In addition to just-in-time work schedules, children whose families experience homelessness and frequent moves (high mobility) are further behind in school on average than children whose families are similarly poor but have more stable housing.²⁵ Even

when moves are not due to financial problems or family crisis, they appear to have a negative impact on children. For example, children in military families who moved had more mental health problems the year after the move than those in military families who did not move the year before.²⁶

Part of a healthy, predictable environment involves a sense of controllability. Our brains are exquisitely capable of detecting when our actions produce results, and awareness of this association activates neural reward systems. Monkeys will work hard simply to make something happen, even when they are not rewarded externally. Simply being the one to do it (agency) activates reward circuitry. When caregiving is sensitive, a child's feeling of agency increases, and this reduces children's fearfulness. For example, by one year of age, children will smile and laugh if they are the ones turning on a loud, cymbal-clapping toy monkey, but will often cry and act frightened if the monkey starts clapping cymbals suddenly on its own.²⁷ Much of our experimental and thus causal evidence for the importance of a responsive, controllable environment for development comes from studies of nonhuman animals.²⁸ Social interactions are so important that monkeys reared in isolation have trouble learning and interacting with peers throughout their lives.²⁹ However, the more the motherless monkey is reared by surrogates that react to their actions, the more typical their development. At the low end, simply putting an inanimate cylinder covered in cloth (the "mother") on a pole that swings each time the baby hops on, as opposed to remaining stationary, helps yield somewhat more typical development. At the high end, having highly responsive dogs be the surrogate caregivers results in development that is remarkably typical.³⁰ Similar results have been observed in rodents, where variations in caregiving are associated with the development of learning and memory skills, as well as the emergence of stress-regulation abilities.³¹ And as noted earlier, variations in early caregiving are associated with regulatory changes in the genes that control facets of the stress response (that is, the glucocorticoid receptors).³²

Children benefit from support of their agency, and age- and skill-appropriate limits set on what they can control. As one famous developmentalist used to say, "the child needs to be in the driver's seat, but the parents have to set the rules for the road."³³ Having a goal blocked – that is, not getting a demand met – can help children develop the regulatory abilities to deal with anger and frustration without aggression. Having choices allows children to refine adaptive decision-making skills, but having too many choices or developmentally inappropriate choices can be overwhelming. Sensitive caregiving involves creating environments in which children can begin making behavioral choices within the boundaries and constraints that are appropriate for their age and developmental level. Indeed, there is evidence that when adults are too responsive, overly protective, or overly permissive, children may struggle to handle even everyday emotional challenges.³⁴

The third theme that emerges from developmental science is the critical role of safety and social support. Humans are social animals, and our brains appear to be organized to form and depend upon relationships with others. While sensitive and responsive care supports so many aspects of healthy development, children can and do form emotional bonds with caregivers who are insensitive, unpredictable, and/or neglectful. But the latter relationships can leave children failing to feel safe and protected. This is important because children's own feelings about their sense of safety affect the way their stress response systems develop.

Humans evaluate situations as stressful when an outcome is important, and failure or harm is anticipated because of a lack of competency or resources.³⁵ Long before children are able to manage threats on their own, their appraisal of their resources to cope with threat largely depends upon the availability of supportive caregivers who, by their presence, signal safety. Indeed, across species and developmental stages, safety signals play a critical role in responding to fear and stress.³⁶ In fact, there is evidence that brain regions involved in triggering defensive responses are always active, which allows us to respond quickly when we are threatened. Safety signals increase activity in brain regions that dampen the activity of these threat-responsive circuits, holding them in check. When caregivers are consistent and reliable, infants come to expect that these caregivers will both respond to their needs and protect them from harm.³⁷ Unquestionably, threats occur in everyone's lives and all humans encounter situations that elicit varying degrees of threat. When children encounter these experiences with a sensitive caregiver on hand for support, children benefit from positive practice and growth experiences. They learn more about the world and their abilities to handle challenges.

Like adults, how children react to a potentially stressful event depends on whether they perceive it as threatening.³⁸ As noted earlier, having control over producing (or choosing not to produce) an event, like making a loud toy activate, flips an arousing toy from being scary to funny. But young children encounter many situations that are unfamiliar, and uncertainty leads them to reference the reactions of those around them whose reactions they trust. Most of us have seen a child be surprised by some event and look to their caregiver to see how they are reacting. Interestingly, by the early preschool years, children seem to analyze which of the other people around them should know whether an odd thing is dangerous or not. For example, when something unexpected happens at childcare and both the parent and the childcare provider are present, children tend to look to the provider as the trusted source of knowledge, whereas in other settings, they would look to the parent. The adults in a child's life are thus in a powerful position to shape the child's view of new situations, people, objects, and events. Caregivers who act timid or frightened of new people and situations provide information that these situations are causes for worry, reinforcing children's natu-

ral wariness. Likewise, children take cues from their caregivers about how upset they should be when something happens. When young children trip and fall to the ground, they often look up at their caregivers prior to crying. Calm reassurance from those caring for the child serves as a safety signal (at times preempting tears), while distress or alarm on the part of the parent or teachers serves as a signal of danger. Ignoring or rebuffing the child (for example, telling them, “Don’t be a crybaby”) also fails to signal safety.

In many situations, simply the presence of a trusted adult can serve as a stress buffer, signaling safety and reducing the activation of physiological stress responses. For example, among toddlers, having a parent with whom they have a secure relationship present and sitting quietly while the child encounters arousing and potentially scary events, such as a loud toy, can block elevations in stress hormones.³⁹ In contrast, fearful children with an insecure parental relationship show marked elevations in stress hormones in the same situation. Going to the doctor for a checkup and shots elevates cortisol for many children, but being with a parent with whom the child has a secure attachment buffers these elevations.⁴⁰ The power of the parent to serve as a stress buffer appears to continue throughout childhood. In children as old as twelve years, even just giving the child the opportunity to talk to a parent on the phone after the child delivered a stressful speech lowered children’s stress responses.⁴¹

The power of the parent as a stress buffer appears to wane during pubertal development. This does not mean that parents cannot be supportive of their adolescent child’s attempts to manage the stresses and challenges of being a teenager; they can and do. But their support appears to be more powerful if they provide a sounding board for the teen working through how they themselves will manage whatever is stressing them out.⁴²

So far, we have focused on what caregivers (such as parents and teachers) do through their presence and ways of interacting with children to help the children feel safe and nurtured. We should also mention that there are forces beyond the control of individual caregivers that are critical in affecting the child’s sense of safety that also have significant impacts on children’s health and well-being.⁴³ Family finances and structural factors, such as structural racism, impact where families can live. Neighborhoods vary in the resources available to children and families to thrive and, critically, in the likelihood that children will be exposed to violence and cues of danger that threaten the child’s physical and psychological safety. Many children live in regions of the world undergoing war and violence where no one can feel safe. For families of color, to keep their child safe, they must discuss ways for the child to protect themselves from being harmed by the police or others, which involves informing them of their vulnerability and lack of safety. There is growing evidence that place-based factors have a major impact on children’s development and on their expectations of safety, danger, and how long they will live. Other es-

says in this volume examine the various types of caregiving that need to be considered in order to support the healthy and sustainable future of all.

The early environment plays a profound role in shaping a child's development, and parents, grandparents, teachers, and childcare providers, among other adults, make up a major component of a child's world. Predictability, age-appropriate sensitivity in these adults' responses, and safety have emerged as features of optimal caregiving. These elements are intricately linked, working together to create an environment in which children can effectively learn and thrive. A predictable and safe environment can provide children with a sense of emotional security. When children can anticipate events and routines, they feel more in control and are better able to regulate their emotions. An unpredictable environment can lead to heightened stress and anxiety in children, challenging their ability to regulate their emotions effectively. Predictable routines can support cognitive development by providing a structured framework for learning, wherein children can more easily anticipate and engage with consistent features in their environments. Predictable environments also allow children to learn appropriate behaviors and social norms through consistent modeling and reinforcement. Caregivers are the pillars that provide this consistency and the safety that allows children to explore their worlds.

Recognizing the importance of predictability underscores the critical role that caregivers play in a child's development. Consistent routines and sensitive interactions titrated to a child's developmental level and needs foster healthy emotional, cognitive, and social growth. Moreover, neuroscience underscores the importance of early experiences in shaping the developing brain. Caregiving practices also impact the brain's stress response system. Chronic stress in childhood can have detrimental effects on brain development, leading to long-lasting changes in the brain's structure and function. Neuroscientific studies have shown that children exposed to consistent caregiving, particularly in times of stress, have more robust and adaptable stress response systems, which are crucial for resilience in the face of adversity. In contrast, neglect or inconsistent parenting can lead to dysregulated stress responses, which may contribute to mental health issues later.

Scientific findings from the field of child development can empower those who care for children to make informed decisions regarding the children under their care. These data can and should also inform public policies to increase access to environments that offer these features to children. Making decisions based on scientific evidence ensures that caregivers are employing strategies that have been thoroughly researched and tested, increasing the likelihood of positive outcomes for children. Attention to the ages at which experiences are offered to children, efforts at creating the most consistent environments possible for children, and having environments that allow children to feel safe and supported are

all science-based approaches through which caregiving can best promote child well-being.

But caregivers cannot do it alone. They need to be in environments that provide the resources needed to operationalize best practices in culturally sensitive ways with the tools at their disposal. They need not only access to evidence-based child development information, but opportunity to use that information. This means that the broader society needs to support children and those who care for them, and to understand and prioritize these essential features of the early environment. By doing so, we can pave the way for a brighter future for the next generation.

AUTHORS' NOTE

We thank Anna M. Bechner for her assistance with the preparation of this manuscript.

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