American Psychological Association
Developmental Psychology

0012-1649/19/$12.00
2019, Vol. 55, No. 9, 1889–1907
http://dx.doi.org/10.1037/dev0000675

Fear in Infancy: Lessons From Snakes, Spiders, Heights, and Strangers

Vanessa LoBue
Rutgers University

Karen E. Adolph
New York University

This review challenges the traditional interpretation of infants' and young children's responses to three types of potentially "fear-inducing" stimuli—snakes and spiders, heights, and strangers. The traditional account is that these stimuli are the objects of infants' earliest developing fears. We present evidence against the traditional account, and provide an alternative explanation of infants' behaviors toward each stimulus. Specifically, we propose that behaviors typically interpreted as "fearful" really reflect an array of stimulus-specific responses that are highly dependent on context, learning, and the perceptual features of the stimuli. We speculate about why researchers so commonly misinterpret these behaviors, and conclude with future directions for studying the development of fear in infants and young children.

Keywords: anxiety, avoidance, fear, threat, wariness

Fear can be an adaptive emotional response if it leads to behaviors that promote safety—avoiding traversal over the edge of a cliff or recoiling from a poisonous snake or spider. Indeed, many adults have experienced something like fear of heights and are afraid—or at least leery—of snakes and spiders. The prevalence of these fears in adults and their seemingly adaptive nature have led researchers to assume that such fears develop in infancy.

Here, we challenge the traditional interpretation of infants' behavior toward stimuli that commonly elicit fear in adults. We focus on three fears highlighted in the literature as holding a special status in early development: fear of snakes/spiders, heights, and strangers. Researchers have proposed other fears that emerge in infancy such as separation anxiety (e.g., Bowlby, 1960). However, we focused on infants' expression of fear toward snakes/spiders, heights, and strangers because researchers have touted evolutionary origins for each, an early emergence in development, and universality across children and a variety of nonhuman animals. Moreover, each presumed "fear" fits neatly into explanations about the adaptive significance of avoiding inhabitants and features of the natural environment that might threaten survival.

Although these three types of "scary" stimuli are often grouped together as "fear-inducing" (e.g., Boyer & Bergstrom, 2011; Marks & Nesse, 1994), we argue that infants display a very different suite of behaviors toward each. Furthermore, in all three cases, we find that infants' responses are complex not simple, situation-specific not global, and highly variable not automatic. Based on our reevaluation of infants' behaviors toward snakes/spiders, heights, and strangers, we conclude that complex, situation-specific, and variable behaviors are far more adaptive than the traditional fear account might suggest, and carry important lessons for how researchers should approach the study of infant fear in future work.

Vanessa LoBue, Department of Psychology, Rutgers University; Karen E. Adolph, Department of Psychology, New York University.

This research was supported by National Institute of Mental Health Grant R01-MH109692 to Vanessa LoBue and by National Institute of Child Health and Human Development Grant R37-HD33486 and R01-HD33486 to Karen E. Adolph.

Correspondence concerning this article should be addressed to Vanessa LoBue, Department of Psychology, Rutgers University, 101 Warren Street, Room 301, Newark, NJ 07102. E-mail: vlobue@psychology.rutgers.edu

What Is Fear?

How do you know if someone is afraid? At first blush, identifying fear seems obvious. In everyday life, people experience fear in themselves and observe fear in others. But for researchers, identifying fear has proven difficult, especially in preverbal infants. Indeed, after more than 100 years of scientific study, researchers have not reached broad consensus about the definition of fear or any other emotion in people of any age (Coan, 2010). As Barrett (2006b) says, "Our everyday experiences of anger, sadness, fear, and several other emotions are compelling, but they are scientifically elusive and defy clear definition," (p. 20). Although researchers agree that fear is a response to imminent perceived threat (Delgado, Olsson, & Phelps, 2006; Ferrari, 1986), they do not agree on the specifics of what constitutes a fearful response. As a result, research has splintered into two broad theoretical frameworks with different implications for identifying fear in infants and young children.

According to the traditional, *discrete* emotions approach, *fear* (and other "basic" emotions such as anger, sadness, and happiness) is a dedicated neural circuit that is activated automatically by an external event without conscious awareness (Ekman & Cordaro, 2011; Izard, 2007; Panksepp, 2007). From this perspective, emotions like fear are biologically based, and can be treated as natural kinds. Accordingly, the state of *fear* causes a narrow set of stereotyped responses that are highly intercorrelated and unique from other emotions.

In contrast, *emergent* approaches characterize *fear* (and other emotions) as a multicomponent process rather than a state (Coan, 2010; Lewis & Douglas, 1998). Several emotion theories can be included under the umbrella of emergent approaches (e.g., constructivist, appraisal, and dimensional theories). According to emergent, or process-based approaches, emotions like *fear* are not natural kinds, but instead emerge from the conscious experience of a confluence of physiological and behavioral responses to the environment (e.g., Barrett, 2006a; Coan, 2010; Clore & Ortony, 2008). The process may unfold as a series of "appraisals" about the significance of an event (Frijda, 1986; Frijda & Mesquita, 1998; Lazarus, 1991a, 1991b; Lewis & Douglas, 1998). During the initial appraisals, subcortical brain regions such as the amygdala are activated and accompanied by autonomic arousal that prepares the body for action. Physiological changes in the body (accelerated heart rate, sweating, etc.) are registered in subsequent appraisals, where additional information about the stimulus and its context are represented in the prefrontal cortex, allowing for comparison of previous events with the present situation (Cunningham & Zelazo, 2007, 2009). *Fear* is only differentiated as a discrete emotion late in the process when early information is combined with interpretations of the environment and predictions about the future (Barrett, 2006b; Clore & Ortony, 2000; Coan, 2010; Cunningham, Dunfield, & Stillman, 2013; Lewis & Douglas, 1998). Thus, according to emergent approaches, *fear* does not *cause* a narrow set of stereotyped responses; instead, early physiological changes combined with representations about how those changes relate to the environment cause *fear* to emerge (Coan, 2010).

In addition to these two broad theoretical frameworks, two additional approaches are common in the developmental literature. The functionalist approach conceptualizes emotions by the potential functions they serve, and views emotion as a goal-oriented, adaptive process. It is similar to the discrete emotions perspective in that each emotion serves a specific function, but functionalists also emphasize the relations between individuals and their environments. The dynamic systems approach focuses on the process by which emotions emerge based on contextual factors, and similar to the emergent perspective, views emotion as a process instead of a state (for review, see Witherington & Crichton, 2007).

These opposing theoretical perspectives carry different implications for studying the development of fear. The discrete emotions view expects evidence of fear in very young infants because the suite of fearful responses (including a fearful facial expression) requires only activation of the requisite neural circuits. Furthermore, researchers adopting this view should expect various measures of fear to strongly cohere. A functionalist perspective would consider infants' behaviors in terms of their adaptive significance in coping with challenges in the environment, and thus privileges goal-directed behaviors over facial expressions. In contrast, both the emergent and dynamic systems approaches expect a protracted developmental trajectory because of the cognitive prerequisites required to interpret environmental events and predict the future. On these accounts, expressions of distress in young infants might reflect only general negative affect, and negative emotions become differentiated with other developing abilities (Camras, 2011; Lazarus, 1991b; Lewis & Douglas, 1998; Sroufe, 1997).

Here, we take an emergent approach to evaluating fear in infants. We define *normative fear* as a reasonable response to imminent threat (i.e., danger or the potential for physical harm) that magnifies as the proximity of the threat increases, whereas clinical fears and phobias are unreasonable, do not take the proximity of the threat into account, and interfere with daily life (Broeren, Lester, Muris, & Field, 2011; Lang, Davis, & Ohman, 2000). On this definition, contextual factors are particularly important because fear responses should vary based on both the proximity of a threatening stimulus and the conscious appraisal of how physiological changes relate to events in the environment. Classically, Lang (1968) proposed that emotions such as fear include three primary response systems: subjective feelings and cognitions expressed as verbal reports, behavioral changes such as avoidance and negative affect, and physiological changes in heart rate and other measures. Infants cannot use language, so in the absence of verbal report, we require evidence from *multiple converging behavioral and/or physiological measures* (Buss, 2011). Despite the fact that most researchers disagree on exactly what an emotion is, there is wide agreement that emotions are primarily affective responses (see pp. 1–44, Fox, Lapate, Shackman, & Davidson, 2018). Thus, to conclude that an infant is experiencing fear, we require behavioral evidence of negative affect, *plus at least one* additional converging behavioral (e.g., avoidance) or physiological (e.g., change in heart rate) measure. Using these criteria, we evaluate whether infants' responses to snakes/spiders, heights, and strangers constitute evidence of early developing fears.

The Lore and Allure of Three Classic Infant Fears

Classic developmental research suggests that between 8 and 10 months of age, infants rapidly detect the presence of snakes and spiders (DeLoache & LoBue, 2009; LoBue & DeLoache, 2010), avoid heights at the edge of a drop-off (Bertenthal, Campos, & Barrett, 1984), and withdraw at the approach of a stranger (Scarr & Salapatek, 1970; Sroufe, 1977). Infants' responses to snakes/spiders, heights, and strangers fit nicely into explanations about the adaptive significance of avoiding animals, places, and people that threaten survival. Indeed, such negative responses toward snakes/spiders, heights, and strangers appear to be universal across cultures and are documented across a variety of nonhuman animals. As a result, all three "fears" are part of the lore in the psychological literature.

"Fears" of strangers and heights have a long history in developmental psychology. The "stranger approach" and "visual cliff" paradigms, which purport to test fear of strangers and heights respectively, are among the most famous paradigms in infant research (Slater & Quinn, 2012). As a result, the top ten grossing developmental psychology textbooks state that infants acquire "fear" or "wariness" of heights (Berk, 2012, 2013; Kail, 2012; Lightfoot, Cole, & Cole, 2013; Martin & Fabes, 2009; Shaffer & Kipp, 2014), display "stranger fear," "stranger anxiety," or "wariness of strangers" (Berger, 2014; Berk, 2012, 2013; Boyd & Bee, 2012; Kail, 2012; Martin & Fabes, 2009; Santrock, 2014; Shaffer & Kipp, 2014) in the first year of postnatal life, or make both types of claims (Berk, 2012, 2013; Kail, 2012; Martin & Fabes, 2009; Shaffer & Kipp, 2014; Siegler, DeLoache, Eisenberg, & Saffran, 2014). Fear of heights and snakes/spiders had an additional entre into the psychological literature: Because these fears are overrepresented among adults' intense fears and phobias, researchers from clinical, social, and evolutionary backgrounds posit adaptive significance for these fears, and hypothesize that responses to snakes and spiders are based on dedicated brain circuitry that is activated automatically on contact with these stimuli (Öhman & Mineka, 2001).

Although textbooks often present outdated research, the lore about early emerging "fear" of snakes, spiders, heights, and strangers is also represented in empirical papers. In general, research on stranger "fear" fell out of favor in the early 1980s. Contemporary emotion researchers use the stranger approach paradigm to reveal individual differences in infants' responses to novelty (e.g., Goldsmith & Rothbart, 1999). However, theorists who do not typically use stranger approach in their labs still refer to stranger "fear" as universal and early developing (e.g., Boyer & Bergstrom, 2011). The idea that infants demonstrate "fear" or "wariness" of heights is alive and well (e.g., Dahl et al., 2013; Saarni, Campos, Camras, & Witherington, 2006; Ueno et al., 2018), and research on infants' "fearful" or "negative" responses to snakes and spiders is beginning to bloom (e.g., DeLoache & LoBue, 2009; Erlich, Lipp, & Slaughter, 2013; Hoehl, Hellmer, Johansson, & Gredeback, 2017). Here, we review classic and contemporary research on infants' responses to snakes/spiders, heights, and strangers, present criticisms of the classic "fear" account, and provide an alternative interpretation of infants' responses to each stimulus.

Fear of Snakes and Spiders

Historical story. Humans' sordid relationship with snakes and spiders is documented throughout recorded history. From the serpent in the Garden of Eden and Medusa to modern-day films like *Arachnophobia* and *Snakes on a Plane,* snakes and spiders symbolize evil and capitalize on adult fears (see Figure 1). One reason that these depictions are so powerful is that snake and spider fears are common in the grand pantheon of human fears. Indeed, fear of snakes and spiders is so common that decades of researchers proposed adaptive, evolutionary origins (Agras, Sylvester, & Oliveau, 1969; Curtis, Magee, Eaton, Wittchen, & Kessler, 1998; Depla, ten Have, van Balkom, & de Graaf, 2008): "The predatory defense system has its evolutionary origin in a prototypical fear of reptiles in early mammals who were targets for predation by the then dominant dinosaurs. Thus, because of this system, contemporary snakes and lizards remain powerful actual fear stimuli" (Öhman & Mineka, 2001, p. 486).

Seligman (1971) asserted that presumably ancient predators such as snakes and spiders hold a privileged status among human fears. He argued that general learning mechanisms (classical and operant conditioning, observational learning, and transmission of verbal information) cannot account for why certain intense fears and phobias—fear of snakes/spiders, heights, enclosed spaces, and blood/injury—are more common than other fears. Because fear of dangerous predators promotes a potential evolutionary advantage, Seligman proposed that snake and spider fears are "prepared," meaning that these fears are especially easy and quick to acquire and more resistant to extinction. In support of prepared learning, lab-reared adult rhesus monkeys quickly exhibit fear of live snakes (fear vocalizations, refusal to approach the snake) after watching a conspecific react fearfully toward a live or video-recorded snake, and the monkeys do not acquire the same fear of rabbits or flowers after watching the same video display (e.g., Cook & Mineka, 1990). Although human adults do not show faster learning, they do display slower extinction for learned associations between a mild electric shock and photographs of snakes/spiders than between a shock and photographs of flowers/mushrooms (Öhman, Fredrikson, Hugdahl, & Rimmo, 1976; for review, see Öhman & Mineka, 2001).

Some researchers assert that snake/spider fear is innate and need not be learned at all (Poulton & Menzies, 2002). In support of this nonassociative view, many adults with snake/spider fears and phobias cannot recall specific experiences that account for their fears; people with fears of other presumed evolutionary threats (e.g., heights, water) also lack salient memories of negative experiences. In contrast, many people can recount specific experiences that instigated fears with no presumed evolutionary origin (e.g., fear of the dentist).

The nonassociative theory presumes that fear of snakes/spiders (and other potential evolutionary threats) should emerge early in development, and that infants and young children should avoid engagement "from the earliest possible encounters" (Poulton & Menzies, 2002, p. 133). The prepared learning view takes a more moderate approach by proposing that learning is required in the acquisition of fear responses; however, proponents of this view argue that rapid fear learning is governed by an evolved fear module or a set of dedicated brain circuitry that is activated automatically at contact with a recurrent evolutionary threat, like a snake or spider, fitting nicely with a discrete emotions perspective. This view implicates rapid fear learning for snakes and spiders, and also rapid detection *from an early age* (Öhman & Mineka, 2001). However, despite widespread theorizing about the origins of snake and spider fears, only recently have developmental researchers examined infant and young children's responses to adults' most feared creatures.

On first glance, developmental research appears to support evolutionary accounts of snake and spider fears, suggesting that infants have a predisposition to quickly fear these animals. For example, infants show more robust and faster associations between snakes and fearful voices than between snakes and happy voices. Seven- to 16-month-olds look longer at a dynamic snake video than a side-by-side video of another animal (elephant, giraffe, etc.) while listening to a central soundtrack of a fearful voice, but not a happy voice (DeLoache & LoBue, 2009); they do not show differential looking to videos of the other animals paired with fearful or happy voices. Similarly, 11-month-old girls—but not boys—associate photographs of snakes and spiders with fearful emoticons, but they do not learn to associate images of flowers and

Figure 1. Depictions of snakes and spiders in art and media. Left, *Adam and Eve,* 1526, by Lucas Cranach the Elder. Retrieved from https://commons.wikimedia.org/wiki/File:Lucas_Cranach_d._%C3%84._001.jpg. In the public domain. Right, *Medusa,* 1597, by Caravaggio. Retrieved from https://commons.wikimedia.org/wiki/File:Medusa_by_Caravaggio.jpg. In the public domain. See the online article for the color version of this figure.

mushrooms with happy or fearful emoticons (Rakison, 2009). Nine-month-olds show larger startle eyeblink responses and lower heart rate while listening to the sound of a hissing snake (and other presumed "evolutionary threats") compared with "happy" sounds (e.g., baby laughing) or modern "threats" such as a bomb exploding (Erlich et al., 2013). And infants as young as 6 months of age show lower heart rate, faster startle responses (Thrasher & LoBue, 2016), and increased pupil dilation to snakes and spiders when compared with other animals (Hoehl et al., 2017).

Similarly, infants and young children exhibit rapid detection of snakes and spiders in visual search tasks, consistent with research demonstrating that adults detect snakes and spiders automatically (Öhman, Flykt, & Esteves, 2001). For example, infants show faster visual detection and greater attention to snakes and spiders than to images of control targets: When presented with side-by-side images of a snake and a flower on a large screen, 9- to 12-month-olds turn more quickly to look at snakes than to flowers (LoBue & DeLoache, 2010); 5-month-olds look longer at schematic images of spiders than to scrambled images of spiders (Rakison & Derringer, 2008). Three- to 5-year-olds find a snake target more quickly in a 3 × 3 matrix of flower distractors than flower, frog, or caterpillar targets among snakes (LoBue & DeLoache, 2008); see Figure 2. Similarly, children detect spiders more quickly than mushrooms and cockroaches (LoBue, 2010). Older children, adults, and adult monkeys do likewise (see LoBue & Rakison, 2013, for a review).

Criticisms: Do infants and children really fear snakes and spiders? Initially, researchers—including the first author of this article—interpreted previous findings as evidence for snake and spider fear early in development (DeLoache & LoBue, 2009; LoBue & DeLoache, 2008; Rakison, 2009; Rakison & Derringer, 2008). Indeed, at first blush, it appears that these data, particularly the data with infants, "offer support for the view that humans have a predisposition to associate snakes with fear" (DeLoache & LoBue, 2009, p. 206). However, on closer examination, two lines of evidence suggest that infants' biased perceptual responses to snakes and spiders are not indicative of fear.

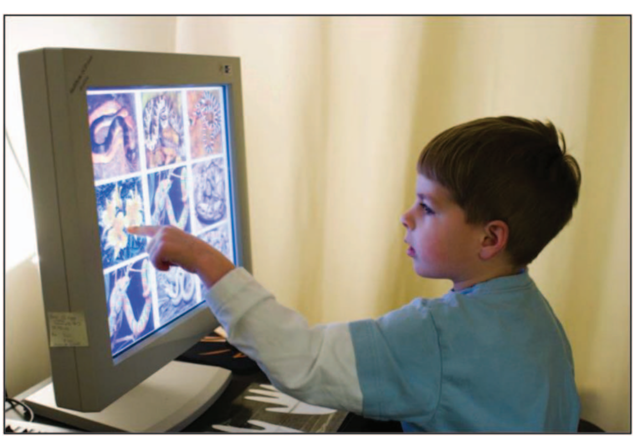

Figure 2. Preschooler detecting a flower target among snake distracters in a 3 × 3 matrix from LoBue & DeLoache (2008). Reprinted from "Detecting the snake in the grass: Attention to fear-relevant stimuli by adults and young children," by V. LoBue & J. S. DeLoache, *Psychological Science, 19*, p. 285. Copyright, 2008 by Sage. Reprinted with permission. See the online article for the color version of this figure.

First, infants and young children show no corroborating behavioral evidence of fear—or any other emotion—in any study with snakes or spiders (LoBue & Rakison, 2013). In the infant studies, 9-month-olds within arm's reach of a video display of a snake, elephant, or giraffe did not avoid looking at snakes relative to the other animals, they did not show differential looking toward snakes, and they were not more reticent to touch the image of the snake (DeLoache & LoBue, 2009). Rather, infants frequently attempted to "pick up" moving snakes from the screen as if the images were real, just as they do while viewing two-dimensional depictions of "friendly" objects in books or on a TV screen (DeLoache, Pierroutsakos, Uttal, Rosengren, & Gottlieb, 1998; Pierroutsakos & Troseth, 2003). In the visual detection studies, some parents reported that their preschool-age children were afraid of snakes or spiders, but parents' reports of fear were unrelated to children's speed of detection (LoBue, 2010; LoBue & DeLoache, 2008). Moreover, parents' reports of child "fear" may reflect parents' attitudes about snakes and spiders, not children's emotions.

Second, young children behave as if they *like* snakes and spiders. During free play, 18- to 36-month-olds spent more time with live animals than with novel toys, and they spent as much time peering into the tanks of a snake and a tarantula—often with nose pressed against the glass—as they did for a hamster and a fish (LoBue, Bloom Pickard, Sherman, Axford, & DeLoache, 2013). Children showed no evidence of avoiding the live snake and spider. Rather, they demonstrated an avid *interest* in all of the live animals, including the snake and the spider, interacting with them longer than they did with a set of highly attractive toys.

Alternative interpretation: Children have early perceptual biases for snakes and spiders. The developmental research presented above shows no evidence of an early developing fear of snakes and spiders. Based on our own definition of fear, children show no evidence of snake and spider fear from multiple converging measures—although children and infants demonstrate heightened/rapid attention toward these stimuli, they show no evidence of negative affect or avoidance behavior. Regardless of whether snake and spider fears are acquired more rapidly than fears of other stimuli, there is no evidence that children have learned them by preschool age. But if infants are not afraid of snakes and spiders, how do we explain infants' differential responses to these stimuli?

We propose that snakes and spiders do hold a special status for infants and children—they capture attention—but physiological responses to snakes and spiders based on rapid detection, voice-image associations, and visual interest are not equivalent to fear and do not reflect any sort of valenced response in the absence of negative affect or avoidance. Thus, this pattern of responding reflects a *perceptual bias* for snakes and spiders (LoBue, 2013; LoBue & Rakison, 2013; LoBue, Rakison, & DeLoache, 2010). A perceptual bias is simply heightened or preferential attention, and can be driven by a number of factors, many of which have nothing to do with a fearful, threatening, or negative valence.

Evidence for a perceptual bias for snakes and spiders comes from the fact that people do not need any emotion or even evidence of "snakeness" for rapid detection of snakes. Low-level perceptual features of snakes are sufficient to elicit rapid detection. Young children and adults, for example, detect snake-shaped stimuli such as coiled wires or simple curvilinear lines more quickly than noncoiled or rectilinear lines (LoBue, 2014; LoBue & DeLoache, 2011). Furthermore, when snakes are presented in an uncoiled position or when only the snake's face is visible, viewers do not show more rapid detection compared with other stimuli (LoBue & DeLoache, 2011). Thus, the curved shapes characteristic of a snake's body and a spider's legs and/or their anomalous movements could support rapid perceptual differentiation of snakes and spiders from other animals, flowers, and mushrooms.

Although fear or any emotional response is unnecessary for a perceptual bias, perceptual biases can be augmented by emotional or cognitive factors. For example, adults detect simple curvilinear lines faster when the lines are labeled as a snake or when adults are exposed to a fearful emotional induction such as brief viewing of a scary movie (LoBue, 2014). Furthermore, adults with a snake or spider phobia detect the object of their fear faster than nonphobic adults (Öhman et al., 2001). Finally, new biases can be acquired by training adults to associate negative words (Gerritsen, Frischen, Blake, Smilek, & Eastwood, 2008), an aversive loud noise (Koster, Crombez, Van Damme, Verschuere, & De Houwer, 2004; Milders, Sahraie, Logan, & Donnellon, 2006), or an unpleasant electric shock (Purkis & Lipp, 2009) with previously neutral stimuli.

Together, the existing body of work demonstrates that infants, children, and adults attend to snakes and spiders very quickly. Evidence of a perceptual bias for snakes and spiders isn't necessarily inconsistent with fear, but given the lack of any corroborating behavioral evidence of fear, we conclude that infants are not afraid of them. Thus, these findings do not support the notion that snake and spider fears are innate. One could still argue, however, that evidence for rapid detection of snakes and spiders in infants and young children supports the evolutionary prepared learning view that dedicated brain circuitry—an "evolved fear module"—is automatically activated on contact with a snake or spider, or another *recurrent evolutionary threat* (Öhman & Mineka, 2001). However, two sources of evidence argue against this perspective. First, data showing that low-level shapes can elicit rapid detection indicate that potential threats or negative valance are not necessary for rapid detection (LoBue, 2014; LoBue & DeLoache, 2011). Second, although perceptual biases for snakes and spiders do not necessarily require learning, data showing that new perceptual biases for neutral stimuli can be learned and that existing biases can be changed by simple experimental manipulations suggest that circuitry involved in rapid stimulus detection is not necessarily domain specific for evolutionary threats like snakes and spiders (Gerritsen et al., 2008; Koster et al., 2004; Milders et al., 2006; Purkis & Lipp, 2009). In fact, perceptual, cognitive, and emotional factors can elicit rapid detection. Thus, characterizing a perceptual bias for snakes and spiders as a singular, automatic process that is *specific to recurrent evolutionary threats* ignores the immense flexibility involved in how such biases develop.

Fear of Heights

Historical story. An infant peering over the edge of a glass table into an apparent abyss is one of the most famous and iconic images in developmental psychology. The glass table—dubbed a "visual cliff" because the drop-off is only illusory—is an apparatus devised originally by Gibson and Walk to test depth perception in dark-reared rats (Walk, Gibson, & Tighe, 1957). A centerboard divides the table into a "shallow" side (a visually specified surface is affixed to the glass) and a "deep" side (the ground surface is visible far beneath the glass). Although the glass was intended to control for haptic and auditory depth cues in rats and other animals, it also functions to ensure the safety of human infants. Thus, the visual cliff turned out to be an even more famous paradigm for testing the behavior of human infants and other animals at the edge of an apparent drop-off (for review, see Adolph & Kretch, 2012). As reported in Gibson and Walk's (1960) classic paper in *Scientific American*, most infants crawl straight over the shallow side to their caregivers, but avoid crossing the deep side despite caregivers' entreaties. Similarly, when allowed to freely explore the apparatus, nonhuman animals stick primarily to the shallow side. When placed directly onto the glass on the deep side—a situation more akin to being shoved off the edge of a cliff than exploring the precipice from the edge—kittens, kids, lambs, monkeys, and other infant animals show stereotyped fear responses such as freezing, backing up, and leaping to the shallow side (Walk, 1966; Walk & Gibson, 1961).

Fueled by the classic work and the flurry of studies that followed, the received wisdom was that infants avoid an apparent drop-off because they are afraid of heights; see, for example, Campos and colleagues' (1978) chapter, "The Emergence of Fear on the Visual Cliff." In Scarr and Salapatek's (1970) words, "it is obviously reasonable to conclude that most infants develop fear of cliffs" (p. 76). And as Dahl et al. (2013) put it, "Avoidance of drop-offs is so biologically adaptive that one would expect it to be present at the earliest testing opportunity" (p. 1361).

Subsequent work tempered Gibson and Walk's (1960) suggestion that "the ability to perceive and avoid a brink [is] part of the child's original endowment" (p. 64). Rather, human infants (and other altricial animals, such as kittens and rabbits) require several weeks of self-produced locomotor experience before they avoid the deep side of the visual cliff (Bertenthal & Campos, 1984; Held & Hein, 1963; Walk, 1966). Similarly, human infants require several weeks of locomotor experience before they avoid crossing a real cliff, steep slope, narrow bridge, narrow ledge, or gap in the surface of support (Adolph, 1997, 2000; Adolph, Tamis-LeMonda, Ishak, Karasik, & Lobo, 2008; Franchak & Adolph, 2012; Kretch & Adolph, 2013a, 2013b; Tamis-LeMonda et al., 2008). Note, when testing infants on a real precipice without safety glass, an experimenter follows alongside infants to rescue them if they begin to fall, or infants wear a harness that prevents them from falling (Adolph & Robinson, 2015; Burnay & Cordovil, 2016). Novice crawlers and walkers plunge straight over the brink of a large drop-off. Over weeks of locomotor experience, infants' motor decisions become increasingly attuned to their abilities. After about 20 weeks of everyday locomotor experience, infants precisely calibrate attempts to cross to tiny changes in drop-off height, degree of slant, bridge width, ledge dimensions, and gap size (for review, see Adolph & Robinson, 2015). Figure 3 shows illustrations of some of the test apparatuses.

Based on this newer work, the revised fear account was that self-produced locomotion leads to fear of heights, and fear in turn leads to avoidance (Bertenthal et al., 1984; Campos et al., 2000; Campos, Bertenthal, & Kermoian, 1992; Campos, Hiatt, Ramsay, Henderson, & Svejda, 1978). This story is common in chapters: "Experience with self-produced locomotion, either through crawling or through the use of a walker, gives rise to the phenomenon of wariness of heights," (*Handbook of Child Psychology*, Saarni et al., 2006, p. 235), and in developmental textbooks, "Seven-month-

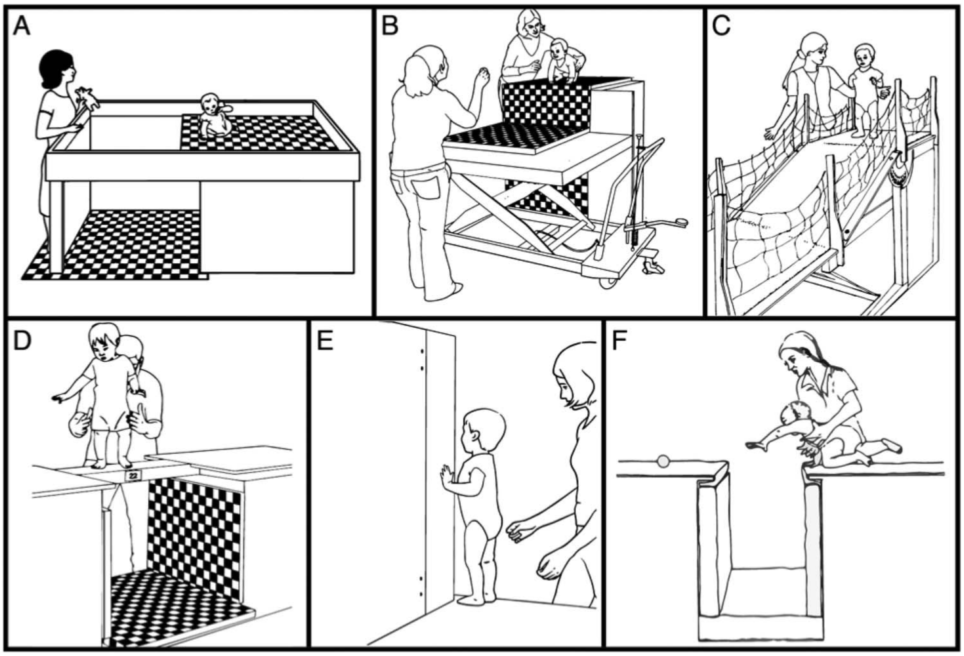

Figure 3. Apparatuses used to test infants' reactions to heights. (A) Standard visual cliff. The entire apparatus is covered in safety glass so the drop-off is only illusory. On the "deep" side, the checkerboard-patterned floor surface is 102 cm below the centerboard; on the "shallow" side, it is 3 cm below the centerboard. (B) Actual cliff. Height of the drop-off adjusts from 0 to 90 cm in 1-cm increments. (C) Adjustable slope apparatus. Slant adjusts from 0° to 90° in 2° increments. (D) Bridge apparatus. Bridge width adjusts from 2 to 60 cm in 2-cm increments. (E) Adjustable ledge apparatus. Ledge width adjusts from 0 to 70 cm in 1-cm increments. (F) Adjustable gap apparatus. Gap width adjusts from 0 to 90 cm in 2-cm increments.

old crawling babies begin to show fear of heights, and infants who push themselves around in walkers also develop a fear of the cliff . . . as do children who are newly walking" (Martin & Fabes, 2009, *Discovering Child Development*, 2nd ed., pp. 144–145).

Criticisms: Do infants really fear heights? Despite decades of undergraduates learning that infants avoid an apparent drop-off because they are afraid of heights, several lines of evidence argue against the fear account (Adolph, Kretch, & LoBue, 2014; Kretch & Adolph, 2013a). First, researchers have no independent corroboration that fear mediates avoidance. The evidence for fear is the avoidance response itself. The argument is circular and goes something like this: Infants avoid a drop-off because they are afraid, and we know infants are afraid because they avoid the drop-off. In principle, infants might feel afraid and therefore avoid the drop-off—a perfectly functional response. But researchers cannot conclude that the reason for avoidance is fear because infants might also feel positive emotions or no emotion at all and perform the same functional avoidance response.

In support of the fear account, infants who can crawl show accelerated heart rate—a standard index of fear—when placed directly on the deep side of the visual cliff, but prelocomotor infants do not (Campos et al., 1978, 1992). Accelerated heart rate, however, does not provide independent evidence of fear because infants show different responses in the placing paradigm (where they are lowered onto the drop-off, simulating an impending fall) and the crossing paradigm (where they can decide whether or not to go). Infants with two weeks of crawling experience show accelerated heart rate in the placing paradigm, but they do not avoid crossing until 6 or more weeks of crawling experience (Campos et al., 1992). Moreover, the same infants whose hearts pound in the placing paradigm crawl over the deep side when tested moments later in the crossing paradigm (Ueno, Uchiyama, Campos, Dahl, & Anderson, 2012). Thus, accelerated heart rate may indicate arousal, not fear. Indeed, accelerated heart rate frequently accompanies positive behaviors such as smiling.

Like heart rate, infants' facial expressions and vocalizations do not provide corroborating evidence of fear. Infants display primarily positive or neutral social expressions at the edge of a visual cliff or steep slope, regardless of whether they avoid going or attempt to cross (Adolph, Karasik, & Tamis-LeMonda, 2010; Adolph et al., 2008; Sorce, Emde, Campos, & Klinnert, 1985; Tamis-LeMonda et al., 2008). As Saarni et al. (2006) put it, infants who avoid crawling over the deep side of the visual cliff "do not show prototypic fear expressions. Indeed, they often smile!" (p. 231). Researchers making the case for fear of heights argue that the emotional system in infancy is not sufficiently coherent to produce negative affective displays in response to fear eliciting situations (e.g., Campos, Frankel, & Camras, 2004). However, infants express negative affect (e.g., crying or fussing) in response to an appropriate elicitor within the first few months of life (Camras et al., 2007; Camras, Oster, Campos, Miyake, & Bradshaw, 1992; Camras & Shutter, 2010; Camras, Sullivan, & Michel, 1993; Ekman & Oster, 1979; Oster, Hegley, & Nagel, 1992), suggesting that they are perfectly capable of demonstrating negative affect in response to something unpleasant. Thus, an equally reasonable interpretation is that infants enjoy the problem of coping with locomotion over a precipice.

A second line of evidence against the fear account concerns the notion of avoidance and infants' proximity to the brink. Although the term "avoidance" implies that infants shy away from the brink, they do not. While tested on a visual cliff, real cliffs, slopes, bridges, and gaps, infants spend most of each trial right at the brink of the precipice, peering over the edge, stretching an arm into the abyss, and exploring the edge of the obstacle with hands and feet (Adolph, 1997, 2000; Adolph et al., 2008; Gibson & Walk, 1960; Kretch & Adolph, 2013a, 2017; Tamis-LeMonda et al., 2008; Ueno et al., 2012; Walk, 1966; Witherington, Campos, Anderson, Lejeune, & Seah, 2005). On the visual cliff, crawling infants are scored as "avoiding" even if they place both hands and a leg onto the safety glass before stopping or returning to the starting platform (Ueno et al., 2012; Witherington et al., 2005); on a real drop-off, they would have fallen. Moreover, on most trials, infants who avoid crossing a drop-off in their typical method of locomotion find alternative methods of descent. They do not avoid the drop-off; instead they find a different way to navigate it. On the visual cliff, they take a detour route to their caregivers by holding onto the wooden walls of the apparatus (Campos et al., 1978). Infants navigate real cliffs by backing down feet first and they slide down steep slopes in sitting, backing, and prone positions (Adolph, 1997; Karasik, Tamis-LeMonda, & Adolph, 2016; Kretch & Adolph, 2013a). Given the importance of the notion of "avoidance" for the fear account, it is noteworthy that the term "avoidance" is more misnomer than descriptor of infants' behavior.

A third line of evidence against fear of heights is differential responding when infants' abilities are altered. If adaptive behavior at the brink of a drop-off depends on fear of heights, then infants should refuse to cross regardless of the current status of their abilities. This is not the case. Infants, for example, walk successfully down slopes while wearing feather-weight shoulder packs, but refuse to walk down the same slopes—with the same drop-off height—while wearing lead-weight shoulder packs that reduce their level of walking skill (Adolph & Avolio, 2000). Similarly, infants walk down shallow slopes while barefoot or wearing rubber-soled shoes, but refuse to walk down the same shallow slopes while wearing slippery Teflon-soled shoes (Adolph, Joh, & Eppler, 2010; Adolph, Karasik, et al., 2010). More dramatic, infants who refuse to cross an impossibly large gap in an experienced sitting posture, crawl repeatedly into the gap (and fall) in a novice crawling posture (Adolph, 2000). Experienced crawlers refuse to crawl down impossibly steep slopes and high drop-offs, but same-aged novice walkers go right over the edge and fall (Adolph et al., 2008; Karasik et al., 2016; Kretch & Adolph, 2013a). When tested longitudinally, infants show separate learning curves for crawling and walking, and learning is no faster the second time around (Adolph, 1997). If locomotor experience teaches infants fear of heights, they should be afraid regardless of the posture in which they are tested.

A final argument against fear of heights concerns infants' evaluation of the severity of a fall. If infants understand that falling from a large drop-off poses a greater threat (incurring greater risk of injury) than falling from a small drop-off, then infants should treat large drop-offs as scarier than small ones. In studies with the visual cliff, real cliffs, and slopes, the probability of falling covaried with the severity of the potential fall: Larger drop-offs accompanied a greater probability of falling. Thus, we cannot distinguish between adaptive responding to a drop-off based on perceiving the probability of falling and adaptive responding based on gauging the severity of a potential fall. But when the probability of falling and the severity of the potential fall are unconfounded by varying bridge width over large and small drop-offs, infants do not respond to the severity of the potential fall (Kretch & Adolph, 2013b). Note that bridge width affects the probability of falling, whereas drop-off height affects the severity of the potential fall. Experienced crawlers and walkers only attempt to cross bridges of adequate width, but their attempt rates, latency, exploratory activity, and crossing behavior are identical for bridges spanning a 17-cm precipice (infants' knee height) and a 71-cm precipice (infants' standing height). Regardless of bridge width and drop-off height, infants do not show any evidence of fear. Indeed, infants walk straight to the edge of the bridge at the start of each trial and spend the rest of their time right at the edge of the precipice or crossing the bridge (Kretch & Adolph, 2017). These results indicate that experienced crawlers and walkers accurately perceive possibilities for locomotion, but they do not yet consider the severity of a potential fall when making decisions for action.

Alternative interpretation: Infants learn to perceive body-environment relations. Ample evidence indicates that locomotor experience teaches infants to behave adaptively at the edge of a drop-off. Moreover, drop-offs do hold a privileged status for young infants compared with other obstacles. Although babies happily fall repeatedly on flat ground, on slippery or squishy ground, and on upward slants and elevations, and repeatedly wedge themselves into impossibly tight openings, they avoid falling into a precipice as soon as they can distinguish possible drop-offs from impossible ones (Adolph, 1995, 1997; Adolph et al., 2012; Adolph, Joh, et al., 2010; Franchak & Adolph, 2012; Joh & Adolph, 2006). Nonetheless, little evidence implicates fear of heights in adaptive responding. Infants, like older children and adults, frequently do not perform behaviors they perceive to be impossible. Further, there is no converging evidence of fear of heights from behavioral (e.g., avoidance) and physiological (e.g., heart rate) measures, and there is no variability in infants' responses to heights based on contextual information (e.g., severity of the fall). In fact, Eleanor Gibson, who instigated researchers' fascination with infants at the edge of a drop-off, did not believe that fear was required for adaptive responding. In her words

> It is worth mentioning that . . . we were never struck by an animal's apparent fear of the deep side of the cliff. All the non-human animals, to the extent they could see it, simply avoided it. Human infants occasionally cried, but that was attributable to a frustrated urge to get to their mothers, who were calling to them across the invisible surface. Later work supported the observation that fear of drop-offs was learned, probably after self-initiated locomotion is well under way. But by that time, it could easily be learned from anxious parents. (Gibson, 1991, p. 105)

But if not fear of heights, what do infants learn over weeks of crawling and walking experience that allows them to distinguish possible drop-offs from impossible ones? Gibson offered an alternative interpretation: Infants learn to detect the fit between the current status of their bodies and the relevant characteristics of the environment that makes a particular action possible or impossible, or as she dubbed it, they learn to perceive "affordances" for locomotion (Adolph & Kretch, 2015; Gibson, 1991; Gibson & Pick, 2000; Gibson & Schumuckler, 1989). They do so via various exploratory behaviors that generate information for the body–environment fit (Adolph & Robinson, 2013; Gibson et al., 1987).

A related alternative explanation is that experienced crawlers and walkers respond to the discrepancy between the structure of optic flow on flat ground versus at the edge of an abrupt drop-off (Dahl et al., 2013). In fact, precrawling infants who receive "artificial" locomotor experience by driving a powered mobility device show more sensitivity to peripheral, lamellar optic flow—a source of information for visual proprioception—and are less likely to cross the deep side of the visual cliff compared with precrawlers who do not receive locomotor experience. Similarly, crawling infants' visual proprioception predicted whether they would descend onto the deep side of a visual cliff.

The data are consistent with these accounts. On adjustable apparatuses that allow continuous gradations of drop-off height, slant, gap size, bridge width, and so on, researchers can obtain precise estimates of infants' ability to perceive affordances (Franchak & Adolph, 2014). The general strategy is to determine for each infant a psychophysical function that describes the probability of success given that they attempt (the ratio of successes to failures) and a second function that describes the likelihood of attempting (the ratio of attempts to refusals to attempt). The correspondence between the two functions reveals infants' ability to perceive affordances accurately. For example, when tested in their first weeks of crawling and walking at the edge of an adjustable slope, infants attempt all degrees of slant indiscriminately. With each week of locomotor experience, the affordance function changes as their bodies grow and crawling and walking skill increases. At the same time, their motor decisions become increasingly attuned such that errors (failed attempts) steadily decrease. Eventually, experienced crawlers and walkers can gauge affordances so accurately that they attempt only possible increments and refuse to attempt impossible ones (Adolph, 1997).

Over weeks of locomotor experience, exploration becomes increasingly directed and efficient. Novice crawlers and walkers do not know when and how to explore and so they expend energy on fruitless methods of information gathering. In contrast, experienced crawlers and walkers display highly efficient patterns of exploration, organized in time and space. Information-gathering "ramps up," such that information obtained moments earlier elicits more costly forms of exploration moments later (Adolph, 1997; Adolph & Eppler, 1998; Adolph, Eppler, Marin, Weise, & Clearfield, 2000; Kretch & Adolph, 2017). While approaching a drop-off, for example, infants see the precipice from the periphery of their field of view. If the obstacle is trivial, they run straight across. But if a casual glance suggests something amiss, exploratory activity ramps up to more time consuming and/or labor-intensive forms of information-generating behaviors. They turn their gaze to the obstacle and stop at the edge to engage in haptic exploration, by poking an arm or a leg into the precipice or over the gap to obtain information about relative distance, placing their hands or feet at the edge of a bridge to see whether there is room for their body, rocking their feet at the brink of a slope to obtain information about slant and friction, and so on. If they decide that the obstacle is impossible, they test alternative methods of locomotion by holding a support post while taking a few tiny tentative steps, or by shifting their posture from upright to prone, sitting, and backing positions. If they discover an alternative, they attempt to go, and if not, they remain on the starting platform until the trial ends.

All told, there is little evidence that infants are afraid of heights. Researchers have consistently failed to find converging measures of fear at the edge of a precipice, and infants do not "avoid"—or shy away from—the edge of real or apparent drop-offs. Furthermore, infants do not demonstrate differential responding to various sized drop-offs based on the level of threat they present. And finally, during all of their exploratory probing, checking, testing, and attempting, infants rarely express negative affect.

Fear of Strangers

Historical story. Fear of strangers has a long history in developmental science. Prior to any documented observations, psychoanalysts introduced the notion in their theoretical writings (e.g., Bridges, 1932). Perhaps due to its common-sense appeal, the notion was then incorporated into attachment theory—still unaccompanied by data—along with the proposal that fear of strangers represents the onset of infants' attachment to their mothers (Bowlby, 1969; Schaffer, 1966; Schaffer & Emerson, 1964; Spitz, 1950). Inspired by these theoretical claims, the basic "stranger approach" paradigm was developed in which an experimenter (man or woman) wearing a positive or neutral facial expression and normal clothes approaches the infant, and researchers score the infant's response. Empirical work on stranger fear burgeoned in the 1970s and soon fear of strangers became widely regarded as a universal milestone in infants' emotional development (Horner, 1980; Solomon & Decarie, 1976).

Consistent with psychoanalytic and attachment theories, several early empirical studies reported stranger fear in nearly every infant tested (for review, see Rheingold & Eckerman, 1974). For example, Tennes and Lampl (1964) reported stranger fear in 18 of 19 infants tested, Schaffer (1966) observed it in all 36 infants tested, and Emde, Gaensbauer, and Harmon (1976) found it in all 14 infants tested. Based on these early reports that stranger fear emerges in virtually every infant studied, many researchers concluded that fear of strangers is universal. Indeed, researchers documented fear of strangers in infants from multiple cultures (e.g., Goldberg, 1972) and fear of strange conspecifics in rats, dogs, and rhesus monkeys (Marks, 1987). Across this diverse group, stranger fear follows a similar developmental trajectory: It emerges after some period of absence, peaks, and then declines. This story still dominates developmental textbooks:

> The most frequent expression of an infant's fear involves stranger anxiety, in which an infant shows fear and wariness of strangers. Stranger anxiety usually emerges gradually. It first appears at about 6 months of age in the form of wary reactions. By 9 months, the fear of strangers is often more intense, and it continues to escalate through the infant's first birthday. (Santrock, 2014, p. 286)

Criticisms: Do all infants really fear strangers? Despite widespread dissemination and common sense appeal, researchers levied important criticisms against stranger fear (Rheingold & Eckerman, 1974). One problematic issue is that many studies base their diagnosis on a set of behaviors that are quite mild—a "sober" (meaning a "serious" or neutral) facial expression, a shift from positive to neutral facial expressions, gaze aversion, and cessation of activity. And in most studies, even these mild responses are limited to a small subset of infants at any given age (Emde et al., 1976; Tennes & Lampl, 1964). For example, Campos, Emde, Gaensbauer, and Henderson (1975) reported that during each phase of their testing session (i.e., mother departs; stranger #1 enters and departs; mother enters; stranger #2 enters and departs), at most, only 33% of infants expressed *any form of distress*, including very mild negative affect. In fact, positive and "affiliative" behaviors, such as smiling, looking, and offering the stranger toys, are most common across studies (Bronson, 1972; Lewis, Brooks, & Haviland, 1978; Lewis & Rosenblum, 1974; Solomon & Decarie, 1976; Sroufe, 1977). Bretherton and Ainsworth (1974) reported that 12-month-olds smiled and looked at the stranger more than at their mothers. Similarly, Sroufe (1977) observed little distress in 8- to 12-month-olds during stranger approach, even when infants were not in contact with their mothers; instead, infants repeatedly looked toward the stranger or smiled, often wearing a "sober, intent expression" (p. 736) instead of a fearful one. Brooks and Lewis (1976) reported similar findings: The most common responses during approach were lessened activity and an attentive facial expression; "negative affect . . . gaze aversion, frowning, and moving away were virtually nonexistent" (p. 329). Lewis et al. (1978) observed some negative facial expressions toward strangers, but no infants cried or attempted to escape. Waters, Matas, and Sroufe (1975) described only "subtle negative responses" to strangers (p. 348), which were generally followed by positive affect. Such findings led Rheingold and Eckerman (1974) to express doubt that infants universally display "frank fear" of strangers (which involves crying) or compelling evidence of fear (fussing, withdrawal) at any age. In their words: "We have studied more than 500 different 10- and 12-month-old infants in the laboratory, investigating a variety of problems. To each infant the experimenter was a stranger, male or female, and a stranger seen in a new environment—strange, if you wish. Only the rare baby has shown any behavior that resembled fear of the stranger" (p. 188).

A second criticism of stranger fear concerns the reliability of the evidence. Indeed, early findings were highly inconsistent (Waters et al., 1975). Although some studies reported evidence of stranger fear in every infant tested (e.g., Emde et al., 1976; Schaffer, 1966; Tennes & Lampl, 1964), others reported few negative responses to strangers, and reported mostly positive or affiliative responses (e.g., Bronson, 1972; Lewis et al., 1978; Lewis & Rosenblum, 1974; Solomon & Decarie, 1976; Sroufe, 1977). Some studies found relations between physiological and behavioral measures of stranger fear (Campos et al., 1975), but others did not (Lewis et al., 1978). Some studies found heart rate acceleration, a common correlate of fear, at the stranger's approach (Campos et al., 1975). Other studies found heart rate deceleration, a response more in line with interest or orienting than with fear (Lewis et al., 1978; Waters et al., 1975).

A third line of evidence against a universal stranger fear is that only some variations of the stranger approach procedure elicit any sort of negative response. For example, when tested at home (rather than in the laboratory), infants demonstrate almost no negative behaviors during stranger approach (Ricciuti, 1974; Smith, 1974). Similarly, when mothers hold their 9-month-olds during stranger approach, none of the infants cry and less than 10% show signs of being "uneasy"; most infants smile or are neutral (Bronson, 1972). More infants cry (~10%) or show uneasiness (~45%) during stranger approach when infants are seated on the floor. But even in the most aversive version of the procedure—when the stranger picks up the infants—only 60% cry or show uneasiness and the rest are smiling or neutral.

Alternative interpretation: Fear of strangers depends on both context and individual differences. Taken together, the body of research on infants' responses to strangers suggests that some infants do show both negative affect and increased heart rate in response to a stranger, and that the frequency of these responses varies based on contextual factors (e.g., tested in the lab vs. at home). Thus, based on our theoretical framework, this body of work does suggest that some infants are indeed afraid of strangers. However, only a subset of infants shows negative affect in face or voice, attempt to escape, and show physiological changes. Further, such responses are highly dependent on context, and do not characterize the majority of infants in most studies. Across studies, most infants show longer looking and smiling/offering toys mixed with a sober facial expression and cessation of activity in response to a stranger. Thus, to describe stranger fear as a universal phenomenon that emerges in every infant at some point in development (e.g., Emde et al., 1976; Schaffer, 1966; Tennes & Lampl, 1964) is overly simplistic, and ignores the variability between infants and contexts. So how, then, do we more accurately characterize this suite of behaviors?

To more accurately interpret data from the extant literature, it is important to consider developmental changes in infants' responses to strangers across studies, alongside the nature of individual differences among infants and contexts. Infants' behaviors indicate that they can differentiate strangers from familiar people such as their mothers at a very early age, long before anyone claims that strangers elicit fear. In the stranger approach paradigm, 5- and 6-month-olds look longer at strangers than at their mothers (Bronson, 1972; Lewis et al., 1978; Lewis & Rosenblum, 1974; Sroufe, 1977). Even newborns discriminate their mother's face, smell, and voice from those of an unfamiliar woman (DeCasper & Fifer, 1980; Field, Cohen, Garcia, & Greenberg, 1984; Russell, 1976). Thus, infants can detect a discrepancy between familiar and "strange" people at an early age, and in fact, some researchers have interpreted infants' very early negative responses to strangers as a simple inability to assimilate a discrepant event (e.g., Kagan, 1972), and that such negative responses disappear by 18 months when infants develop the ability to assimilate discrepant events.

Although looking time measures suggest that infants can detect a discrepancy between a familiar and novel person in the first six months of life, this early discrimination is not reflected in other behavioral measures until the second half of the first year. Around this time, variability among experimental set-ups suggests that infants are beginning to use context as a guide for what to do when approached by a novel person, behaving as if strange places and situations are a flag for when the approach of a strange person might be threatening. For example, almost no infants exhibit negative responses to a stranger's approach when tested at home but some react negatively when tested in the laboratory (Ricciuti, 1974; Smith, 1974). Infants show fewer negative responses when their mothers are present versus absent, when they are seated on their mothers' laps as opposed to when they are seated on the floor

(Bronson, 1972), and when they have time to become acclimated to the lab versus when they do not (Sroufe, 1977). Furthermore, the behavior and appearance of the stranger affects infants' responses. When the stranger slowly approaches and stays a few feet away, infants demonstrate few negative responses. In contrast, when the stranger rapidly approaches or touches or attempts to pick up the infant, infants display more negative reactions (Sroufe, 1977). Similarly, a child stranger elicits almost no negative responses, an adult stranger with the height of a child elicits a small increase in negative responses, and a normal-sized adult stranger elicits a larger increase in negative responses (Brooks & Lewis, 1976). Because of such variability across experimental set-ups, some researchers have suggested that behaviors toward strangers require evaluation—assessing the meaning or significance of a target stimulus—and fear only emerges in some infants when the context is threatening (Brooks & Lewis, 1976; Sroufe, 1977).

Infants also show variability in their responses to strangers based on individual differences in emotionality or temperament—infants' own bias to respond emotionally to novel stimuli. Indeed, researchers have found that the subset of infants who show intense negative responses to strangers are more likely to have a behaviorally inhibited temperament and subsequently grow up to be shy and socially anxious compared with infants who do not respond negatively (Brooker et al., 2013). Furthermore, infants who show the highest levels of anxiety as children often behave as if all novel stimuli are threatening, responding negatively regardless of context (Buss, Davidson, Kalin, & Goldsmith, 2004). In other words, infants who *fail to evaluate* the approach of a stranger based on contextual factors are most at risk for the development of anxiety disorders later in life. As a result, recent work now uses the stranger approach paradigm to characterize individual differences in temperament and to make predictions about the development of social anxiety instead of a universal fear of strangers (Goldsmith & Rothbart, 1999).

To summarize, infants show a complex mix of behavioral responses to strangers. These responses change over the course of development, and although some infants do show fear, fearful responses are highly dependent on context and temperament, with the most extreme responses to strangers resulting from the "strangest" of situations and from the most "fearful" of infants. Altogether, this interpretation is consistent with an emergent view of fear development, which expects a protracted developmental trajectory for the expression of fear based on concurrent developments in infants' ability to interpret the threat-relevance of environmental events. It also suggests that normative fears—reasonable fears that increase as the proximity of threat increases—*should not necessarily be present in every infant*, and instead, should be expected to vary widely based on concurrent developments in cognition, variations in context, and individual differences.

Reasons for Misattribution: A Case of Mistaken Identity

Given the paucity of evidence for a universal fear of snakes, spiders, heights, and strangers in infants and young children, why have researchers perpetuated the idea that these fears emerge in most infants and young children? In the following section, we suggest several factors that might have led researchers to misattribute interest, heightened attention, autonomic arousal, and differential responses for fear. In particular, good storytelling (common sense views about dangerous things and sexy allusions to evolutionary significance), inadequate and confusing terminology (sloppy use of terms, conflation of indices with the fear construct), and measurement problems (adult-centric expectations and interpretations of infant behavior) appear to have led us astray.

Just-So Evolutionary Stories

One explanation for the persistent idea that infants fear snakes/spiders, heights, and strangers is that this idea makes for a good developmental and evolutionary story. Most readers would agree that avoidance of potentially dangerous things is adaptive. Falls from large heights are likely to result in injury (Berry & Miller, 2008), and falling from a height (down stairs, out a window, etc.) is a leading cause of accidental injury in infants (Bulut, Koksal, Korkmaz, Turan, & Ozguc, 2006). However, falling on flat ground or from small heights is frequent in infant walkers—about 100 times a day—and most falls are so trivial that infants do not cry and caregivers do not show concern (Adolph et al., 2012). Although nearly all spiders are technically venomous, most spider bites are not serious health threats (Gold, Dart, & Barish, 2002; Maretić, 1987). However, approximately 14% of snakes are venomous, and snake bites result in 94,000 deaths per year worldwide (Kasturiratne et al., 2008). Strangers are more likely to cause certain types of harm than people inside one's circle of personal friends, family, and acquaintances (Sampson, 1987). Fear enters the story as an emotional mechanism that leads to adaptive behavior. The prevailing notion is that fear prepares the body for defensive actions that promote safety and survival (Bronson, 1974).

The story goes something like this: Snakes/spiders, heights, and strange conspecifics are potential threats—presumably throughout the course of evolution—so it would be adaptive to be afraid of these things because fear would promote safety, survival, and future reproduction (Seligman, 1971). Snakes/spiders, heights, and strangers are a special kind of "natural" threat, different from man-made dangers such as guns, knives, prescription medications, and automobile accidents: "Stimuli that come to be feared are mostly ancient threats: *snakes, spiders, heights*, storms, thunder, lightning, darkness, blood, *strangers*, social scrutiny, separation, and leaving the home range" (Marks & Nesse, 1994, p. 255, italics added). On this logic, it seems reasonable that fear of natural threats would appear early in development, and the leap to an evolutionary "just-so story" is not so large. Thus, researchers may endorse and perpetuate the notion of snake/spider, height, and stranger fear in infants because the storyline is relatively simple and posits links between emotion, behavior, and adaptive function in both ontogenetic and phylogenetic development. In the words of developmental textbook authors, Siegler et al. (2014), "[t]he emergence of such fears is clearly adaptive" (p. 390).

However, the evolutionary story is not as simple and satisfying as it first appears. Height, snake, and spider fears are significantly more common than other fears in adults or children, but they are not at all common (King, Muris, & Ollendick, 2005). Snakes, spiders, and heights (falling) are indeed ranked in the top 10 most common developmental fears, but these fears are documented only in children older than 7 years of age (Muris, Merckelbach, &

Collaris, 1997; Ollendick & King, 1991; Ollendick, King, & Frary, 1989); such fears are not reported widely in infants or preschoolers, and are related to the occurrence of the same fears in parents (Muris, Steerneman, Merckelbach, & Meesters, 1996). About 30% of adults profess nonclinical levels of fear of heights and 40% claim a nonclinical fear of snakes (Agras et al., 1969). But only 5% report intense fears or phobias of heights (Depla et al., 2008) and only 3–6% report intense fears or phobias of snakes or spiders (Fredrikson, Annas, Fischer, & Wik, 1996). Stranger fear in adults is so rare that it does not even have a name. The more general manifestation—"social phobia/anxiety"—affects only 11% of the adult population (Beesdo et al., 2007).

Thus, if it were indeed true that all typically developing infants acquire fear of heights, for example, then researchers would need to explain how most infants *unlearn* this fear over the course of development because only a subset of adults (30%) have any fear of heights (e.g., Fredrikson et al., 1996). More generally, if particular fears emerge in infancy, the challenge for development would be to subsequently lose these fears (Poulton & Menzies, 2002), by habituating to heights over time, for example, or by regulating one's emotional responses. Indeed, researchers have identified an inverted U-shaped developmental trajectory for stranger fear where it emerges after some period of absence, peaks, and then declines by 18 to 24 months of age. An evolutionary story with an inverted U-shaped developmental trajectory is far less satisfying than a story with an upward trajectory to the plotline: Although readers may find it easy to believe that we have early developing fears of evolutionarily relevant threats, it is plausible (via habituation or extinction) but more difficult to believe that the majority of people successfully *unlearn* these fears during development, as unlearning particular fears can be quite difficult (see Ollendick, King, & Muris, 2002).

"Fear" and Other Scary Terms

The "scary" terms used to describe stimuli, paradigms, and infant behavior also contribute to the widespread misattribution of fear for infants' responses to snakes/spiders, heights, and strangers. Many social psychologists, neuroscientists, clinicians, and developmental researchers (again including the first author of this paper) classify these stimuli as "fear-relevant," presupposing that the stimuli will elicit fear (e.g., DeLoache & LoBue, 2009; Erlich et al., 2013; LoBue & DeLoache, 2010; for review, see Öhman & Mineka, 2001; Rakison, 2009). Some researchers have more recently adopted the term "threat-relevant" instead, as it describes the nature of the stimulus instead of the expected emotional response of the participant (e.g., LoBue, Buss, Taber-Thomas, & Perez-Edgar, 2017).

A similar problem exists for the way researchers name paradigms used to elicit "fear" responses. In Pavlovian "fear conditioning," for example, human participants are trained to pair a neutral stimulus (US) with an aversive stimulus (CS) such as a mild electric shock or an unpleasant noise. After repeated pairings, participants learn to associate the US and CS to produce a conditioned response (CR), as indexed by fMRI (activation of particular brain regions such as the amygdala) and skin conductance (sweating; Delgado et al., 2006; LeDoux, 2012). Despite what its name implies, adults do not typically experience the subjective feeling of fear during "fear conditioning." They typically describe the procedure as *unpleasant*, but not fear-inducing (Delgado, Jou, & Phelps, 2011). LeDoux (2012) warned that the term "fear" in studies that measure amygdala responses does not refer to the subjective experience of fear. Instead, these studies measure a neural response to the imminent shock or noise—which may not even be registered by the participant. Similarly, Öhman and Mineka (2001) cautioned that skin conductance responding "reflects processes such as attention . . . interest, and general emotional arousal, which are related to fear but to other emotional processes as well" (p. 489). Such responses have implications for the conscious experience of fear, and may indirectly influence feelings of fear, but they are not equivalent to the subjective experience of fear (LeDoux, 2012). This issue is not unique to the infant literature, as psychologists from many subdisciplines use these confusing terms.

A problem specific to the developmental literature is the multitude of terms used to describe infants' behaviors in response to "fear-relevant" stimuli. The word "fear" itself is used in many studies on infants' responses to strangers (e.g., Emde et al., 1976; Gaensbauer, Emde, & Campos, 1976; Schaffer & Emerson, 1964) and heights (e.g., Campos et al., 1978, 2000; Scarr & Salapatek, 1970). However, because crying and fearful facial expressions are so rarely observed, some researchers argue for the use of softer terms such as "anxiety" or "wariness" for strangers and heights (Batter & Davidson, 1979; Bronson, 1972; Campos et al., 2000; e.g., Campos et al., 1992; Dahl et al., 2013; e.g., Kagan, 1988; Lewis et al., 1978; Möller, Majdandzic, & Bogels, 2014; Tennes & Lampl, 1964; Waters et al., 1975). Regardless, the terms "fear," "anxiety," and "wariness" all describe the same wide range of infant responses. Researchers often use these terms interchangeably within the same paper to refer to fear/anxiety of strangers (Campos et al., 1975) or fear/wariness of heights (Campos et al., 2000), within the same textbook chapter (Berger, 2014; Berk, 2012, 2013; Martin & Fabes, 2009; Santrock, 2014; Shaffer & Kipp, 2014), and sometimes even within a single sentence: "The most frequent expression of an infant's fear involves stranger anxiety, in which an infant shows fear and wariness of strangers" (Santrock, 2014, p. 286); "A wary and fearful reaction to strangers, stranger anxiety, appears at about 7 months" (Martin & Fabes, 2009, p. 221).

All of these scary terms—fear, anxiety, and wariness—connote fear (or at least negative affect), but have very different formal definitions: "Wary" means cautious or careful and, by formal definition, should not necessarily carry an emotional valence; although exact definitions for fear and anxiety are debated in the emotion literature, researchers widely agree that they are not equivalent (see Ekman & Davidson, 1994, Ch. 2, for a discussion). Thus, using scary terms to refer to stimuli designed to elicit fear, paradigms designed to measure fear, and a highly disparate group of behaviors assumed to index fear make *any differential responding* observed in these studies easy to misinterpret.

Measuring Fear Without Words

A third reason for the widespread misattribution of fear concerns the ways that researchers measure fear and interpret their measures. Researchers studying adults can include self-report measures to corroborate any behavioral or neural markers of fear, and indeed many of them do (e.g., Delgado et al., 2011). Unfortunately, infants cannot talk. In lieu of verbal reports of fear from infants, researchers must make two inferential leaps: First, they must set up a situation that is likely to induce fear in infants; and second, they must interpret infants' physiological and behavioral responses in this situation. Both kinds of inferences require adult researchers to guess what babies feel based on their own adult-centric viewpoints.

Most studies designed to measure fear set up a situation where fear is expected, which already puts researchers in a position to exaggerate its prevalence. Many of the original studies on stranger fear, for example, assumed that infants would display stranger fear at some point in development. Thus, the studies were not designed to measure whether or to what extent infants exhibit stranger fear; instead, they were designed to document the age at which infants first exhibit stranger fear. As a result, most of the early studies were conducted longitudinally and any negative or differential response (including merely a "sober" facial expression) was used to mark the onset of stranger fear, making at least one negative response very likely to occur (e.g., Gaensbauer et al., 1976; Schaffer, 1966; Tennes & Lampl, 1964). Similarly, studies on infant fear often use paradigms like stranger approach and the visual cliff because they are widely assumed to produce fearful responses (e.g., Scarr & Salapatek, 1970). Indeed, "the (visual) cliff is widely considered to be one of the strongest elicitors of fear in the human infant" (Campos et al., 2004, p. 389). It is easy to see how such expectations can quickly lead to misattributions. As Lewis (2013, p. 39) pointed out: "We want to measure the fear response so we create situations that we think should lead to fear, and we measure the expressions produced as indicating fear."

Another issue is that researchers often determine what behaviors would indicate fear in infants by focusing on what behaviors would indicate fear in *adults*: "If I did this (set of behaviors) when this occurred (context including stimuli) I would feel fearful" (Lewis & Rosenblum, 1974, p. 3). Expecting to see a fearful response based on our own adult perspective of what fears should look like can easily lead to misattributions. A good example comes from the animal literature. Rat pups "cry" (or more accurately, emit ultrasonic vocalizations) when separated from their mothers. Upon hearing the pup cry, the rat dam returns it to the nest, and soon the pup stops crying. The traditional explanation for this sequence of events is obvious: When pups are separated from their mothers, the pups respond emotionally to the separation and cry out for help (Hofer, Masmela, Brunelli, & Shair, 1998). However, the pups' ultrasonic vocalizations may be merely a physiological byproduct of cooling (Blumberg & Sokoloff, 2001): When a pup is separated from the huddle, it no longer has littermates and the dam's warm pelt to regulate its body temperature. As the pup's body quickly begins to cool, a suite of physiological responses kick in to help the pup survive the cold, including the forced expiration of air through a constricted larynx. Thus, the "cries" that the pups emit when separated from their mothers are the result of the force of air passing through the constricted larynx—not an emotional cry for help. However, for decades, researchers applied their egocentric perspective to interpreting this simple behavior, assuming that ultrasonic squeaks can be compared with an infant crying out for its absent mother.

A similar problem can occur when we let our adult-centric expectations guide the interpretation of infant behavior. When we observe, for example, that infants refuse to cross the visual cliff, we might infer that they are afraid of heights because when *we*, as adults, are afraid of something, we typically do not do it. Likewise, if we *expect* to see fear on the visual cliff, it is easy to conclude that refusal to cross represents that fear. However, behaviors indicative of fear in infants might look very different from behaviors indicative of fear in adults, especially in the absence of corroborating evidence.

Future Directions for Studying Fear in Development

Our review concludes that a subset of infants express fear in response to strangers in some contexts, but we found no evidence to support the case for heights or for snakes and spiders. We do not claim that infants are *incapable* of feeling afraid of heights or snakes/spiders. Rather, we argue that there is no reliable evidence that a large number of infants—or even a subset of infants—experience fear of heights or fear of snakes/spiders.

In this final section, we reflect on how the data reviewed here can guide future research on the development of adults' most common fears. We first revisit the theoretical framework we adopted for the current review, and describe how researchers adopting other frameworks might interpret the same data. We then provide recommendations for how to measure fear in infants based on the findings of our review. We end with a discussion of potential learning mechanisms that might underlie fear acquisition.

Theoretical Considerations

We began this review by describing a serious challenge to the study of emotional development—namely lack of agreement about what constitutes an emotional fear response, and the lack of a gold standard, a clear, objective, definitive set of criteria for identifying fear. Because of inconsistencies in theoretical approaches to the study of emotion, future work should provide a clear description of researchers' theoretical framework, definition of fear, and criteria for identifying fear.

Here, we took an emergent approach to studying infants' responses to snakes/spiders, heights, and strangers, requiring behavioral (e.g., negative facial/vocal expressions and/or avoidance behavior) and/or physiological evidence (e.g., changes in heart rate) to support the presence of fear in the absence of verbal reports. Based on this framework, we only found evidence for a normative fear of strangers in some infants and some experimental set-ups. The emergent framework is sufficiently flexible to account for variability in response to strangers: A perceptual change in the environment (appearance of a stranger) might elicit amygdala activation and physiological changes, but the process most often terminates when later appraisals dismiss the potential for threat (Clore & Ortony, 2000; Coan, 2010). However, in some experimental set-ups (e.g., the mother is absent, the stranger approaches quickly) the environment is sufficiently extreme for appraisals of an approaching stranger to produce negative affect or fear.

In contrast, an emergent approach did not lead us to conclude that infants develop a normative fear of heights or snakes and spiders. However, researchers adopting other theoretical perspectives might interpret the same data quite differently. One example comes from the functionalist approach. Again, researchers adopting this approach organize emotions around the goal or function they serve, and deemphasize the importance of negative affect and specific physiological responses (Witherington & Crichton, 2007). In the case of fear of heights, the function of a fearful response is to safely protect the infant from a dangerous drop-off, and thus refusal to cross might be privileged over other behaviors like negative affect.

Similarly, proponents of the prepared learning account of fear acquisition argue that rapid fear learning is governed by an evolved fear module in the brain; this view fits with a discrete emotions perspective. Based on this perspective, one could argue that the presence of a threatening stimulus like a snake or spider automatically activates the fear module in the brain, and that such activation can occur unconsciously (Öhman & Mineka, 2001). Proponents of this perspective might then interpret *any* evidence of differential responding to stimuli like snakes and spiders as support for the presence of fear, even in the absence of negative affect or avoidance behavior. But again, as LeDoux (2012) and Öhman and Mineka (2001) have suggested, the term "fear" in studies that measure only amygdala activation or unconscious responses to threatening stimuli are not equivalent to the subjective experience of fear. Further, LeDoux (2012) points out that the capacity for organisms to withdraw from a threat—as even single-celled organisms retract from a harmful chemical—should not be equated with fear as an emotion; the former is more consistent with a reflex, or part of what he calls a "survival circuit," which can be found in both humans and nonhuman animals, and does not require cognitive appraisal. It is clear from this example that researchers studying a singular physiological or unconscious response to stimuli like snakes and spiders are perhaps interested in a different construct than researchers studying the experience and expression of fear, which often requires an appraisal. Thus, in future work, researchers should be clear about their theoretical approach, carefully defining their criteria for a particular emotion to facilitate comparisons across studies.

Methodological Considerations

Our review also carries practical implications for measurement. First, methods for measuring fear in infants should contain *multiple* converging measures (Buss, 2011). This should include a behavioral measure of negative affect, and converging evidence from at least one additional behavioral (e.g., avoidance) or physiological measure (e.g., change in heart rate). This recommendation is consistent with the two broad theoretical accounts discussed here: The discrete emotions view *expects* converging evidence because the entire suite of highly correlated fear responses is presumably triggered by activation of the fear circuitry; the emergent view *demands* converging evidence because multiple measures may not be correlated, so several are needed to establish a reliable basis for inferring fear in preverbal infants. Previous work supports only a weak correlation between behavioral, physiological, and in adults, self-report measures of emotion categories, including fear (Barrett, 2006b; Lewis et al., 1978). And in typical fear assessments designed for infants and young children, fear is often viewed as a profile of responses that includes measures of negative facial expressions (both the presence and intensity), bodily signs of fear (e.g., tense muscles, freezing, trembling), startle response, distress vocalizations (e.g., fussing, crying), and attempts to escape (see Lab-Tab, by Goldsmith & Rothbart, 1999). Indeed: "No single behavior is invariably a sign of fear in any species . . . when several protective responses occur together, we can more confidently label them as fear behavior than we can any one response. When only one or two of these are present, their meaning is less clear" (Marks, 1987, p. 10). In other words, collecting only one or two measures of fear increases the likelihood of misattribution, so methods that use multiple converging measures are recommended.

Second, based on our own criteria and definition, normative fears are responses to imminent threat that *should increase as the proximity of the threat increases* (Broeren et al., 2011). Thus, according to an emergent approach, normative developmental fears need not be present in all, or even most, infants. In fact, by definition, normative fears should vary based on contextual information, making any paradigm designed to elicit fear in *all* infants difficult to support with empirical data unless the context is sufficiently extreme and infants have the prior knowledge to conclude that it is threatening. For example, most adults would not be afraid of a corn snake in a terrarium. However, if the same adults encountered an anaconda on a hike through the Brazilian rain forest, most would likely feel afraid. In this example, both the context (terrarium vs. rainforest) and prior knowledge about snakes (corn snake vs. anaconda) are important for whether a fear response is elicited. Indeed, infants' fearful responses to strangers are related to the context in which the stranger is presented. However, the conditions in which researchers have studied snakes/spiders and heights did not produce a fear response, even for heights in cases where the severity of the potential fall was varied (Kretch & Adolph, 2013b). This suggests that infants either do not have the prior knowledge to conclude that snakes/spiders and heights can be potential threats, or that the context in which these stimuli were presented in prior research was not sufficiently extreme to elicit a fear response.

The implication for measurement is that context and prior knowledge are important, and thus fear or any emotional response might best be studied using an individual differences approach, and not as a singular response that can be measured in the same way across all infants and experimental set-ups. Furthermore, if fearful responses are expected to vary based on contextual information, fears that do not vary across different contexts might fall outside the normative range. Indeed, infants who fail to evaluate the approach of a stranger based on contextual factors are most at risk for the development of anxiety disorders later in life (Buss, 2011; Buss et al., 2004). Thus, future researchers taking an individual differences approach to the development of fear might be more successful in characterizing the nature of fearful behavior than studies aimed at constructing experimental set-ups that elicit fear in all infants.

Third, researchers should be aware that the expression of fear is likely to change developmentally alongside infants' ability to evaluate the threat-relevance of a stimulus and their ability to cope or regulate their emotional responses over time. Indeed, besides significant developmental changes in infants' responses to strangers over the first two years of life, there are also significant changes in their use of regulation strategies when approached by a stranger. For example, 6-month-olds are more likely to use gaze aversion than other coping strategies when upset during stranger approach than are older infants. In contrast, 12- to 18-month-olds are more likely than younger infants to engage in self-distraction (e.g., playing with a toy) and self-soothing behaviors such as hand sucking or rubbing (Mangelsdorf, Shapiro, & Marzolf, 1995). Thus, researchers should be careful to consider how fear might be expressed differently in infants and children at different ages, and how the ability to regulate emotional responses might affect the fearful behaviors that are expressed.

Potential Pathways for Fear Learning

A final challenge for future work is to identify the learning mechanisms that might lead to fear of snakes/spiders, heights, and strangers. Several learning pathways have been proposed in the literature (Rachman, 1977). The most dominant is the classical conditioning account, where children learn to assign threat to snakes, for example, if bitten by a snake or assign danger to heights if they incurred a serious fall from a precipice. Although children might best develop fears via classical conditioning, it is unlikely for urban or suburban children in the United States to be bitten by a snake. Thus, two additional pathways might better explain the development of fear of snake/spiders, heights, and strangers.

One learning pathway is by hearing threatening verbal information. For example, transmission via negative verbal information could induce fear of strangers from stranger-danger warnings by parents or teachers. Indeed, there is evidence that most (89%) intense fears in preschool-aged children come from threatening verbal information such as hearing something from parents or friends or seeing something in the media (Ollendick & King, 1991). Another is by the transmission of social information, such as by witnessing a caregiver's fearful responses (i.e., vicarious learning). In preverbal infants who cannot process negative verbal information, social information might be particularly important for early fear learning. Whether infants can develop a long-lasting fear of snakes, spiders, heights, and strangers via social learning is still unknown, but infants' ability to acquire short-term *avoidance* responses to heights, snakes, and spiders has already been established using social referencing paradigms. In fact, some of the earliest research on social referencing came from Sorce et al.'s (1985) demonstration that 12-month-olds avoid crossing an ambiguously high 30-cm. visual cliff when mothers pose a fearful face, but cross when mothers pose a happy face. Similarly, two studies demonstrated that 15- to 20-month-olds show more fearful facial expressions and avoidance behaviors in response to toy snakes, spiders, flowers, and mushrooms after observing mothers' negative facial expressions (Dubi, Rapee, Emerton, & Schniering, 2008; Gerull & Rapee, 2002), suggesting that fear-like behaviors can be elicited via social learning.

Aside from these general learning mechanisms, several factors might make fear learning easier for certain individuals or for certain stimuli. Infants with a reactive temperament are more likely to respond negatively to novel stimuli when compared with infants with a nonreactive temperament (Kagan, Reznick, & Snidman, 1987), and so may be more likely to acquire specific fears. Furthermore, hearing repeated negative information about a stimulus like a snake could create a store of past knowledge, resulting in expectancies that make later conditioning easier (Field & Purkis, 2011). Likewise, stimuli (such as snakes, spiders, heights, and strangers) that elicit specific physiological or attentional responses might be particularly easy to associate with fear (Davey, 2002; LoBue, 2013; LoBue & Rakison, 2013). For example, having a physiological response (e.g., increased heart rate) to a drop-off might facilitate learning by priming infants to explore; indeed, in studies using both visual and real cliffs as well as gaps and slopes, infants spend most of each trial exploring the edge of the precipice (Adolph, 1997, 2000; Adolph et al., 2008; Gibson & Walk, 1960; Kretch & Adolph, 2013a, 2017; Tamis-LeMonda et al., 2008; Ueno et al., 2012; Walk, 1966; Witherington et al., 2005). Similarly, a perceptual bias for stimuli like snakes and spiders might make associative learning easier, because infants' attention is already focused on the stimulus. This proposal fits with emergent theories as well: Differential responses such as heart rate changes or rapid attention could prime the subsequent appraisal of an otherwise neutral stimulus. Thus, if infants are already primed for an appraisal by some physiological or attentional cue, learning might be rapid in the presence of threatening information.

Conclusions: What Is Adaptive Behavior?

Is fear of snakes, spiders, heights, and strangers truly adaptive? When posing an evolutionary story, we have to ask ourselves whether it is really more adaptive for children to have a set of fears that they must subsequently lose or learn to regulate, or whether it is more adaptive for children to possess the flexibility to learn a particular fear when the situation calls for it.

Infants respond to snakes/spiders, heights, and strangers with a varied array of behaviors that include changes in heart rate, rapid detection, approach, exploratory looking and touching, and positive/neutral facial expressions and vocalizations. Traditionally, researchers have assigned a single construct to explain these differential responses—fear. However, as we argue, such differential responding need not be accompanied by fear or any other emotion, or *any* appreciation of the target's meaning. And indeed, infants show differential responding to snakes, spiders, heights, and strangers at younger ages than anyone claims fear—and months before they respond adaptively to these stimuli.

We leave you with one final thought. The classic view—perpetuated for decades in the developmental and evolutionary literatures—is that innate, universal, early fear of snakes/spiders, heights, and strangers is adaptive. We argue that it is not. Such fear—fear without an evaluation of context, and without reference to previous experience—could in fact be *maladaptive*: "When children develop a rigid pattern of behavioral reactivity (e.g., avoid any new situation), they will miss out on opportunities for experiencing new things such as learning new skills or information, and meeting new friends" (Buss, 2011, p. 807). Accordingly, most infants are not afraid of snakes, spiders, heights, or strangers. Instead, they differentiate these stimuli from others, they explore these stimuli to learn about them, and they evaluate the meaning of these stimuli relative to the environment. Although fear of snakes/spiders, heights, and strangers might be adaptive in some instances, heightened attention to these stimuli, the ability to perceive affordances for action when presented with these stimuli, and the ability to evaluate their meaning based on context is far more adaptive: These behaviors encourage infants to explore new things while maintaining the flexibility to develop a fear if they discover that a stimulus is truly threatening.

References

Adolph, K. E. (1995). Psychophysical assessment of toddlers' ability to cope with slopes. *Journal of Experimental Psychology: Human Perception and Performance, 21,* 734–750. http://dx.doi.org/10.1037/0096-1523.21.4.734

Adolph, K. E. (1997). Learning in the development of infant locomotion. *Monographs of the Society for Research in Child Development, 62*(3, Serial No. 251), 1–140. http://dx.doi.org/10.2307/1166199

Adolph, K. E. (2000). Specificity of learning: Why infants fall over a veritable cliff. *Psychological Science, 11,* 290–295. http://dx.doi.org/10.1111/1467-9280.00258

Adolph, K. E., & Avolio, A. M. (2000). Walking infants adapt locomotion to changing body dimensions. *Journal of Experimental Psychology: Human Perception and Performance, 26,* 1148–1166. http://dx.doi.org/10.1037/0096-1523.26.3.1148

Adolph, K. E., Cole, W. G., Komati, M., Garciaguirre, J. S., Badaly, D., Lingeman, J. M., . . . Sotsky, R. B. (2012). How do you learn to walk? Thousands of steps and dozens of falls per day. *Psychological Science, 23,* 1387–1394. http://dx.doi.org/10.1177/0956797612446346

Adolph, K. E., & Eppler, M. A. (1998). Development of visually guided locomotion. *Ecological Psychology, 10,* 303–321. http://dx.doi.org/10.1080/10407413.1998.9652687

Adolph, K. E., Eppler, M. A., Marin, L., Weise, B., & Clearfield, M. W. (2000). Exploration in the service of prospective control. *Infant Behavior & Development, 23,* 441–460. http://dx.doi.org/10.1016/S0163-6383(01)00052-2

Adolph, K. E., Joh, A. S., & Eppler, M. A. (2010). Infants' perception of affordances of slopes under high and low friction conditions. *Journal of Experimental Psychology: Human Perception and Performance, 36,* 797–811. http://dx.doi.org/10.1037/a0017450

Adolph, K. E., Karasik, L. B., & Tamis-LeMonda, C. S. (2010). Using social information to guide action: Infants' locomotion over slippery slopes. *Neural Networks, 23,* 1033–1042. http://dx.doi.org/10.1016/j.neunet.2010.08.012

Adolph, K. E., & Kretch, K. S. (2012). Infants on the edge: Beyond the visual cliff. In A. Slater & P. Quinn (Eds.), *Developmental psychology: Revisiting the classic studies* (pp. 36–55). London, UK: Sage.

Adolph, K. E., & Kretch, K. S. (2015). Gibson's theory of perceptual learning. In H. Keller (Ed.), *International encyclopedia of the social and behavioral sciences* (2nd ed., Vol. 10, pp. 127–134). New York, NY: Elsevier. http://dx.doi.org/10.1016/B978-0-08-097086-8.23096-1

Adolph, K. E., Kretch, K. S., & LoBue, V. (2014). Fear of heights in infants? *Current Directions in Psychological Science, 23,* 60–66. http://dx.doi.org/10.1177/0963721413498895

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* (pp. 403–443). New York, NY: Oxford University Press.

Adolph, K. E., & Robinson, S. R. (2015). Motor development. In L. Liben & U. Muller (Eds.), *Handbook of child psychology and developmental science* (7th ed., Vol. 2: Cognitive processes, pp. 114–157). New York, NY: Wiley. http://dx.doi.org/10.1002/9781118963418.childpsy204

Adolph, K. E., Tamis-LeMonda, C. S., Ishak, S., Karasik, L. B., & Lobo, S. A. (2008). Locomotor experience and use of social information are posture specific. *Developmental Psychology, 44,* 1705–1714. http://dx.doi.org/10.1037/a0013852

Agras, S., Sylvester, D., & Oliveau, D. (1969). The epidemiology of common fears and phobia. *Comprehensive Psychiatry, 10,* 151–156. http://dx.doi.org/10.1016/0010-440X(69)90022-4

Barrett, L. F. (2006a). Are emotions natural kinds? *Perspectives on Psychological Science, 1,* 28–58. http://dx.doi.org/10.1111/j.1745-6916.2006.00003.x

Barrett, L. F. (2006b). Solving the emotion paradox: Categorization and the experience of emotion. *Personality and Social Psychology Review, 10,* 20–46. http://dx.doi.org/10.1207/s15327957pspr1001_2

Batter, B. S., & Davidson, C. V. (1979). Wariness of strangers: Reality or artifact? *Journal of Child Psychology & Psychiatry, & Allied Disciplines, 20,* 93–109. http://dx.doi.org/10.1111/j.1469-7610.1979.tb00490.x

Beesdo, K., Bittner, A., Pine, D. S., Stein, M. B., Höfler, M., Lieb, R., & Wittchen, H.-U. (2007). Incidence of social anxiety disorder and consistent risk for secondary depression in the first three decades of life. *Archives of General Psychiatry, 64,* 903–912. http://dx.doi.org/10.1001/archpsyc.64.8.903

Berger, K. S. (2014). *The developing person through childhood and adolescence* (9th ed.). New York, NY: Worth.

Berk, L. E. (2012). *Infants, children, and adolescents* (7th ed.). Boston, MA: Allyn & Bacon.

Berk, L. E. (2013). *Child development* (9th ed.). Upper Saddle River, NJ: Pearson.

Berry, S. D., & Miller, M. (2008). Falls: Epidemiology, pathophysiology, and relationship to fracture. *Current Osteoporosis Reports, 6,* 149–154. http://dx.doi.org/10.1007/s11914-008-0026-4

Bertenthal, B. I., & Campos, J. J. (1984). A reexamination of fear and its determinants on the visual cliff. *Psychophysiology, 21,* 413–417. http://dx.doi.org/10.1111/j.1469-8986.1984.tb00218.x

Bertenthal, B. I., Campos, J. J., & Barrett, K. C. (1984). Self-produced locomotion: An organizer of emotional, cognitive, and social development in infancy. In R. N. Emde & R. J. Harmon (Eds.), *Continuities and discontinuities in development* (pp. 175–210). New York, NY: Plenum Press. http://dx.doi.org/10.1007/978-1-4613-2725-7_8

Blumberg, M. S., & Sokoloff, G. (2001). Do infant rats cry? *Psychological Review, 108,* 83–95. http://dx.doi.org/10.1037/0033-295X.108.1.83

Bowlby, J. (1960). Separation anxiety: A critical review of the literature. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 1,* 251–269. http://dx.doi.org/10.1111/j.1469-7610.1960.tb01999.x

Bowlby, J. (1969). *Attachment and loss: Vol. 1. Attachment* (2nd ed.). London, UK: Hogarth Press.

Boyd, D., & Bee, H. (2012). *The developing child* (13th ed.). Upper Saddle River, NJ: Pearson.

Boyer, P., & Bergstrom, B. (2011). Threat-detection in child development: An evolutionary perspective. *Neuroscience and Biobehavioral Reviews, 35,* 1034–1041. http://dx.doi.org/10.1016/j.neubiorev.2010.08.010

Bretherton, I., & Ainsworth, M. (1974). Responses of one-year-olds to a stranger in a strange situation. In M. Lewis & L. Rosenblum (Eds.), *The origins of fear* (pp. 131–164). New York, NY: Wiley.

Bridges, K. M. B. (1932). Emotional development in early infancy. *Child Development, 3,* 324–341. http://dx.doi.org/10.2307/1125359

Broeren, S., Lester, K. J., Muris, P., & Field, A. P. (2011). They are afraid of the animal, so therefore I am too: Influence of peer modeling on fear beliefs and approach-avoidance behaviors towards animals in typically developing children. *Behaviour Research and Therapy, 49,* 50–57. http://dx.doi.org/10.1016/j.brat.2010.11.001

Bronson, G. W. (1972). Infants' reactions to unfamiliar persons and novel objects. *Monographs of the Society for Research in Child Development, 37,* 1–46. http://dx.doi.org/10.2307/1165685

Bronson, G. W. (1974). General issues in the study of fear. In M. Lewis & L. A. Rosenblum (Eds.), *The origins of fear* (Vol. 2, pp. 254–258). New York, NY: Wiley.

Brooker, R. J., Buss, K. A., Lemery-Chalfant, K., Aksan, N., Davidson, R. J., & Goldsmith, H. H. (2013). The development of stranger fear in infancy and toddlerhood: Normative development, individual differences, antecedents, and outcomes. *Developmental Science, 16,* 864–878. http://dx.doi.org/10.1111/desc.12058

Brooks, J., & Lewis, M. (1976). Infants' responses to strangers: Midget, adult, and child. *Child Development, 47,* 323–332. http://dx.doi.org/10.2307/1128785

Bulut, M., Koksal, O., Korkmaz, A., Turan, M., & Ozguc, H. (2006). Childhood falls: Characteristics, outcome, and comparison of the Injury Severity Score and New Injury Severity Score. *Emergency Medicine Journal, 23,* 540–545. http://dx.doi.org/10.1136/emj.2005.029439

Burnay, C., & Cordovil, R. (2016). Crawling experience predicts avoidance of real cliffs and water cliffs: Insight from a new paradigm. *Infancy, 21,* 677–684. http://dx.doi.org/10.1111/infa.12134

Buss, K. A. (2011). Which fearful toddlers should we worry about? Context, fear regulation, and anxiety risk. *Developmental Psychology, 47,* 804–819. http://dx.doi.org/10.1037/a0023227

Buss, K. A., Davidson, R. J., Kalin, N. H., & Goldsmith, H. H. (2004). Context specific freezing and associated physiological reactivity as a dysregulated fear response. *Developmental Psychology, 40,* 583–594. http://dx.doi.org/10.1037/0012-1649.40.4.583

Campos, J. J., Anderson, D. I., Barbu-Roth, M. A., Hubbard, E. M., Hertenstein, M. J., & Witherington, D. C. (2000). Travel broadens the mind. *Infancy, 1,* 149–219. http://dx.doi.org/10.1207/S15327078IN0102_1

Campos, J. J., Bertenthal, B. I., & Kermoian, R. (1992). Early experience and emotional development: The emergence of wariness of heights. *Psychological Science, 3,* 61–64. http://dx.doi.org/10.1111/j.1467-9280.1992.tb00259.x

Campos, J. J., Emde, R. N., Gaensbauer, T., & Henderson, C. (1975). Cardiac and behavioral interrelationships in the reactions of infants to strangers. *Developmental Psychology, 11,* 589–601. http://dx.doi.org/10.1037/0012-1649.11.5.589

Campos, J. J., Frankel, C. B., & Camras, L. (2004). On the nature of emotion regulation. *Child Development, 75,* 377–394. http://dx.doi.org/10.1111/j.1467-8624.2004.00681.x

Campos, J. J., Hiatt, S., Ramsay, D., Henderson, C., & Svejda, M. (1978). The emergence of fear on the visual cliff. In M. Lewis & L. Rosenblum (Eds.), *The development of affect* (pp. 149–182). New York, NY: Plenum Press. http://dx.doi.org/10.1007/978-1-4684-2616-8_6

Camras, L. A. (2011). Differentiation, dynamical integration, and functional emotional development. *Emotion Review, 3,* 138–146. http://dx.doi.org/10.1177/1754073910387944

Camras, L. A., Oster, H., Bakeman, R., Meng, Z., Ujiie, T., & Campos, J. J. (2007). Do infants show distinct negative facial expressions for fear and anger? Emotional expression in 11-month-old European, American, Chinese, and Japanese infants. *Infancy, 11,* 131–155. http://dx.doi.org/10.1111/j.1532-7078.2007.tb00219.x

Camras, L. A., Oster, H., Campos, J. J., Miyake, K., & Bradshaw, D. (1992). Japanese and American infants' responses to arm restraint. *Developmental Psychology, 28,* 578–583. http://dx.doi.org/10.1037/0012-1649.28.4.578

Camras, L. A., & Shutter, J. M. (2010). Emotional facial expressions in infancy. *Emotion Review, 2,* 120–129. http://dx.doi.org/10.1177/1754073909352529

Camras, L. A., Sullivan, J., & Michel, G. (1993). Do infants express discrete emotions? Adult judgments of facial, vocal, and body actions. *Journal of Nonverbal Behavior, 17,* 171–186. http://dx.doi.org/10.1007/BF00986118

Clore, G. L., & Ortony, A. (2000). Cognition in emotion: Never, sometimes, or always. In R. D. Lane & L. Nadel (Eds.), *The cognitive neuroscience of emotion* (pp. 24–61). New York, NY: Oxford University Press.

Clore, G. L., & Ortony, A. (2008). Appraisal theories: How cognition shapes affect into emotion. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (3rd ed., pp. 628–642). New York, NY: Guilford Press.

Coan, J. A. (2010). Emergent ghosts of the emotion machine. *Emotion Review, 2,* 274–285. http://dx.doi.org/10.1177/1754073910361978

Cook, M., & Mineka, S. (1990). Selective associations in the observational conditioning of fear in rhesus monkeys. *Journal of Experimental Psychology: Animal Behavior Processes, 16,* 372–389. http://dx.doi.org/10.1037/0097-7403.16.4.372

Cunningham, W. A., Dunfield, K. A., & Stillman, P. E. (2013). Emotional states from affective dynamics. *Emotion Review, 5,* 344–355. http://dx.doi.org/10.1177/1754073913489749

Cunningham, W. A., & Zelazo, P. D. (2007). Attitudes and evaluations: A social cognitive neuroscience perspective. *Trends in Cognitive Sciences, 11,* 97–104. http://dx.doi.org/10.1016/j.tics.2006.12.005

Cunningham, W. A., & Zelazo, P. D. (2009). The development of iterative reprocessing: Implications for affect and its regulation. In P. D. Zelazo, M. Chandler, & E. A. Crone (Eds.), *Developmental social cognitive neuroscience* (pp. 81–98). Mahwah, NJ: Erlbaum.

Curtis, G. C., Magee, W. J., Eaton, W. W., Wittchen, H. U., & Kessler, R. C. (1998). Specific fears and phobias: Epidemiology and classification. *The British Journal of Psychiatry, 173,* 212–217. http://dx.doi.org/10.1192/bjp.173.3.212

Dahl, A., Campos, J. J., Anderson, D. I., Uchiyama, I., Witherington, D. C., Ueno, M., . . . Barbu-Roth, M. (2013). The epigenesis of wariness of heights. *Psychological Science, 24,* 1361–1367. http://dx.doi.org/10.1177/0956797613476047

Davey, G. C. L. (2002). "Nonspecific" rather than "nonassociative" pathways to phobias: A commentary on Poulton and Menzies. *Behaviour Research and Therapy, 40,* 151–158. http://dx.doi.org/10.1016/S0005-7967(01)00046-8

DeCasper, A. J., & Fifer, W. P. (1980). Of human bonding: Newborns prefer their mothers' voices. *Science, 208,* 1174–1176. http://dx.doi.org/10.1126/science.7375928

Delgado, M. R., Jou, R. L., & Phelps, E. A. (2011). Neural systems underlying aversive conditioning in humans with primary and secondary reinforcers. *Frontiers in Neuroscience, 5,* 1–10. http://dx.doi.org/10.3389/fnins.2011.00071

Delgado, M. R., Olsson, A., & Phelps, E. A. (2006). Extending animal models of fear conditioning to humans. *Biological Psychology, 73,* 39–48. http://dx.doi.org/10.1016/j.biopsycho.2006.01.006

DeLoache, J. S., & LoBue, V. (2009). The narrow fellow in the grass: Human infants associate snakes and fear. *Developmental Science, 12,* 201–207. http://dx.doi.org/10.1111/j.1467-7687.2008.00753.x

DeLoache, J. S., Pierroutsakos, S. L., Uttal, D. H., Rosengren, K. S., & Gottlieb, A. (1998). Grasping the nature of pictures. *Psychological Science, 9,* 205–210. http://dx.doi.org/10.1111/1467-9280.00039

Depla, M. F. I. A., ten Have, M. L., van Balkom, A. J. L. M., & de Graaf, R. (2008). Specific fears and phobias in the general population: Results from the Netherlands Mental Health Survey and Incidence Study (NEMESIS). *Social Psychiatry and Psychiatric Epidemiology, 43,* 200–208. http://dx.doi.org/10.1007/s00127-007-0291-z

Dubi, K., Rapee, R. M., Emerton, J. L., & Schniering, C. A. (2008). Maternal modeling and the acquisition of fear and avoidance in toddlers: Influence of stimulus preparedness and child temperament. *Journal of Abnormal Child Psychology, 36,* 499–512. http://dx.doi.org/10.1007/s10802-007-9195-3

Ekman, P., & Cordaro, D. (2011). What is meant by calling emotions basic. *Emotion Review, 3,* 364–370. http://dx.doi.org/10.1177/1754073911410740

Ekman, P., & Davidson, R. J. (1994). *The nature of emotions: Fundamental questions*. United Kingdom: Oxford University Press.

Ekman, P., & Oster, H. (1979). Facial expressions of emotion. *Annual Review of Psychology, 30,* 527–554. http://dx.doi.org/10.1146/annurev.ps.30.020179.002523

Emde, R. N., Gaensbauer, T. J., & Harmon, R. J. (1976). Emotional expression in infancy: A biobehavioral study. *Psychological Issues, 10,* 1–200.

Erlich, N., Lipp, O. V., & Slaughter, V. (2013). Of hissing snakes and angry voices: Human infants are differentially responsive to evolutionary fear-relevant sounds. *Developmental Science, 16,* 894–904. http://dx.doi.org/10.1111/desc.12091

Ferrari, M. (1986). Fears and phobias in childhood: Some clinical and developmental considerations. *Child Psychiatry and Human Development, 17,* 75–87. http://dx.doi.org/10.1007/BF00706646

Field, A. P., & Purkis, H. M. (2011). The role of learning in the aetiology of child and adolescent fear and anxiety. In W. K. Silverman & A. P. Field (Eds.), *Anxiety disorders in children and adolescents: Research, assessment, and intervention* (2nd ed., pp. 227–256). United Kingdom: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511994920.012

Field, T. M., Cohen, D., Garcia, R., & Greenberg, R. (1984). Mother-stranger face discrimination by the newborn. *Infant Behavior & Development, 7,* 19–25. http://dx.doi.org/10.1016/S0163-6383(84)80019-3

Fox, A. S., Lapate, R. C., Shackman, A. J., & Davidson, R. J. (Eds.). (2018). *The nature of emotion: Fundamental questions*. New York, NY: Oxford University Press.

Franchak, J. M., & Adolph, K. E. (2012). What infants know and what they do: Perceiving possibilities for walking through openings. *Developmental Psychology, 48,* 1254–1261. http://dx.doi.org/10.1037/a0027530

Franchak, J. M., & Adolph, K. E. (2014). Affordances as probabilistic functions: Implications for development, perception, and decisions for action. *Ecological Psychology, 26,* 109–124. http://dx.doi.org/10.1080/10407413.2014.874923

Fredrikson, M., Annas, P., Fischer, H., & Wik, G. (1996). Gender and age differences in the prevalance of specific fears and phobias. *Behaviour Research and Therapy, 34,* 33–39. http://dx.doi.org/10.1016/0005-7967(95)00048-3

Frijda, N. H. (1986). *The emotions*. Massachusetts: Cambridge University Press.

Frijda, N. H., & Mesquita, B. (1998). The analysis of emotions: Dimensions of variation. In M. F. Mascolo & S. Griffin (Eds.), *What develops in emotional development* (pp. 273–295). New York, NY: Plenum Press. http://dx.doi.org/10.1007/978-1-4899-1939-7_11

Gaensbauer, T. J., Emde, R. N., & Campos, J. J. (1976). "Stranger" distress: Confirmation of a developmental shift in a longitudinal sample. *Perceptual and Motor Skills, 43,* 99–106. http://dx.doi.org/10.2466/pms.1976.43.1.99

Gerritsen, C., Frischen, A., Blake, A., Smilek, D., & Eastwood, J. D. (2008). Visual search is not blind to emotion. *Perception & Psychophysics, 70,* 1047–1059. http://dx.doi.org/10.3758/PP.70.6.1047

Gerull, F. C., & Rapee, R. M. (2002). Mother knows best: Effects of maternal modeling on the acquisition of fear and avoidance behavior in toddlers. *Behaviour Research and Therapy, 40,* 279–287. http://dx.doi.org/10.1016/S0005-7967(01)00013-4

Gibson, E. J. (1991). *An odyssey in learning and perception*. Cambridge, MA: MIT Press.

Gibson, E. J., & Pick, A. D. (2000). *An ecological approach to perceptual learning and development*. New York, NY: Oxford University Press.

Gibson, E. J., Riccio, G., Schmuckler, M. A., Stoffregen, T. A., Rosenberg, D., & Taormina, J. (1987). Detection of the traversability of surfaces by crawling and walking infants. *Journal of Experimental Psychology: Human Perception and Performance, 13,* 533–544. http://dx.doi.org/10.1037/0096-1523.13.4.533

Gibson, E. J., & Schumuckler, M. A. (1989). Going somewhere: An ecological and experimental approach to development of mobility. *Ecological Psychology, 1,* 3–25. http://dx.doi.org/10.1207/s15326969eco0101_2

Gibson, E. J., & Walk, R. D. (1960). The "visual cliff." *Scientific American, 202,* 64–71. http://dx.doi.org/10.1038/scientificamerican0460-64

Gold, B. S., Dart, R. C., & Barish, R. A. (2002). Bites of venomous snakes. *The New England Journal of Medicine, 347,* 347–356. http://dx.doi.org/10.1056/NEJMra013477

Goldberg, S. (1972). Infant care and growth in urban Zambia. *Human Development, 15,* 77–89. http://dx.doi.org/10.1159/000271231

Goldsmith, H. H., & Rothbart, M. K. (1999). *The laboratory temperament assessment battery* (Locomotor version, Edition 3.1). Madison: University of Wisconsin-Madison.

Held, R., & Hein, A. (1963). Movement-produced stimulation in the development of visually guided behavior. *Journal of Comparative and Physiological Psychology, 56,* 872–876. http://dx.doi.org/10.1037/h0040546

Hoehl, S., Hellmer, K., Johansson, M., & Gredeback, G. (2017). Itsy bitsy spider . . . : Infants react with increased arousal to spiders and snakes. *Frontiers in Psychology, 8,* 1710. http://dx.doi.org/10.3389/fpsyg.2017.01710

Hofer, M. A., Masmela, J. R., Brunelli, S. A., & Shair, H. N. (1998). The ontogeny of maternal potentiation of the infant rats' isolation call. *Developmental Psychobiology, 33,* 189–201. http://dx.doi.org/10.1002/(SICI)1098-2302(199811)33:3<189::AID-DEV1>3.0.CO;2-N

Horner, T. M. (1980). Two methods of studying stranger reactivity in infants: A review. *Journal of Child Psychology & Psychiatry, & Allied Disciplines, 21,* 203–219. http://dx.doi.org/10.1111/j.1469-7610.1980.tb01796.x

Izard, C. E. (2007). Basic emotions, natural kinds, emotion schemas, and a new paradigm. *Perspectives on Psychological Science, 2,* 260–280. http://dx.doi.org/10.1111/j.1745-6916.2007.00044.x

Joh, A. S., & Adolph, K. E. (2006). Learning from falling. *Child Development, 77,* 89–102. http://dx.doi.org/10.1111/j.1467-8624.2006.00858.x

Kagan, J. (1972). Do infants think? *Scientific American, 226,* 74–82. http://dx.doi.org/10.1038/scientificamerican0372-74

Kagan, J. (1988). The idea of emotion in human development. In C. E. Izard, J. Kagan, & R. B. Zajonc (Eds.), *Emotions, cognition, and behavior* (p. 38). Massachusetts: Cambridge University.

Kagan, J., Reznick, J. S., & Snidman, N. (1987). The physiology and psychology of behavioral inhibition in children. *Child Development, 58,* 1459–1473. http://dx.doi.org/10.2307/1130685

Kail, R. V. (2012). *Children and their development* (6th ed.). Upper Saddle River, NJ: Pearson.

Karasik, L. B., Tamis-LeMonda, C. S., & Adolph, K. E. (2016). Decisions at the brink: Locomotor experience affects infants' use of social information on an adjustable drop-off. *Frontiers in Psychology, 7,* 797. http://dx.doi.org/10.3389/fpsyg.2016.00797

Kasturiratne, A., Wickremasinghe, A. R., de Silva, N., Gunawardena, N. K., Pathmeswaran, A., Premaratna, R., . . . de Silva, H. J. (2008). The global burden of snakebite: A literature analysis and modelling based on regional estimates of envenoming and deaths. *PLoS Medicine, 5,* 1591–1604. http://dx.doi.org/10.1371/journal.pmed.0050218

King, N. J., Muris, P., & Ollendick, T. H. (2005). Childhood fears and phobias: Assessment and treatment. *Child and Adolescent Mental Health, 10,* 50–56. http://dx.doi.org/10.1111/j.1475-3588.2005.00118.x

Koster, E. H., Crombez, G., Van Damme, S., Verschuere, B., & De Houwer, J. (2004). Does imminent threat capture and hold attention? *Emotion, 4,* 312–317. http://dx.doi.org/10.1037/1528-3542.4.3.312

Kretch, K. S., & Adolph, K. E. (2013a). Cliff or step? Posture-specific learning at the edge of a drop-off. *Child Development, 84,* 226–240. http://dx.doi.org/10.1111/j.1467-8624.2012.01842.x

Kretch, K. S., & Adolph, K. E. (2013b). No bridge too high: Infants decide whether to cross based on the probability of falling not the severity of the potential fall. *Developmental Science, 16,* 336–351. http://dx.doi.org/10.1111/desc.12045

Kretch, K. S., & Adolph, K. E. (2017). The organization of exploratory behaviors in infant locomotor planning. *Developmental Science, 20,* e1241. http://dx.doi.org/10.1111/desc.12421

Lang, P. J. (1968). Fear reduction and fear behavior: Problems in treating a construct. In J. M. Schlien (Ed.), *Research in psychotherapy* (Vol. 3, pp. 90–102). Washington, DC: American Psychological Association. http://dx.doi.org/10.1037/10546-004

Lang, P. J., Davis, M., & Ohman, A. (2000). Fear and anxiety: Animal models and human cognitive psychophysiology. *Journal of Affective Disorders, 61,* 137–159. http://dx.doi.org/10.1016/S0165-0327(00)00343-8

Lazarus, R. S. (1991a). Cognition and motivation in emotion. *American Psychologist, 46,* 352–367. http://dx.doi.org/10.1037/0003-066X.46.4.352

Lazarus, R. S. (1991b). *Emotion and adaptation*. New York, NY: Oxford University Press.

LeDoux, J. (2012). Rethinking the emotional brain. *Neuron, 73,* 653–676. http://dx.doi.org/10.1016/j.neuron.2012.02.004

Lewis, M. (2013). *The rise of consciousness and the development of emotional life*. New York, NY: Guilford Press.

Lewis, M., Brooks, J., & Haviland, J. (1978). Hearts and faces: A study in the measurement of emotion. In M. Lewis & L. A. Rosenblum (Eds.), *The development of affect* (pp. 77–123). Amsterdam, the Netherlands: Springer. http://dx.doi.org/10.1007/978-1-4684-2616-8_4

Lewis, M., & Douglas, L. (1998). A dynamic systems approach to cognition-emotion interactions in development. In M. F. Mascolo & S. Griffin (Eds.), *What develops in emotional development* (pp. 159–188). New York, NY: Plenum Press. http://dx.doi.org/10.1007/978-1-4899-1939-7_7

Lewis, M., & Rosenblum, L. A. (1974). Introduction: The origins of fear. In M. Lewis & L. A. Rosenblum (Eds.), *The origins of behavior* (Vol. 2, pp. 1–10). New York, NY: Wiley.

Lightfoot, C., Cole, M., & Cole, S. R. (2013). *The development of children* (7th ed.). New York, NY: Worth.

LoBue, V. (2010). And along came a spider: An attentional bias for the detection of spiders in young children and adults. *Journal of Experimental Child Psychology, 107,* 59–66. http://dx.doi.org/10.1016/j.jecp.2010.04.005

LoBue, V. (2013). What are we so afraid of? How early attention shapes our most common fears. *Child Development Perspectives, 7,* 38–42. http://dx.doi.org/10.1111/cdep.12012

LoBue, V. (2014). Deconstructing the snake: The relative roles of perception, cognition, and emotion on threat detection. *Emotion, 14,* 701–711. http://dx.doi.org/10.1037/a0035898

LoBue, V., Bloom Pickard, M., Sherman, K., Axford, C., & DeLoache, J. S. (2013). Young children's interest in live animals. *British Journal of Developmental Psychology, 31,* 57–69. http://dx.doi.org/10.1111/j.2044-835X.2012.02078.x

LoBue, V., Buss, K. A., Taber-Thomas, B. C., & Perez-Edgar, K. (2017). Developmental differences in infants' attention to social and nonsocial threats. *Infancy, 22,* 403–415. http://dx.doi.org/10.1111/infa.12167

LoBue, V., & DeLoache, J. S. (2008). Detecting the snake in the grass: Attention to fear-relevant stimuli by adults and young children. *Psychological Science, 19,* 284–289. http://dx.doi.org/10.1111/j.1467-9280.2008.02081.x

LoBue, V., & DeLoache, J. S. (2010). Superior detection of threat-relevant stimuli in infancy. *Developmental Science, 13,* 221–228. http://dx.doi.org/10.1111/j.1467-7687.2009.00872.x

LoBue, V., & DeLoache, J. S. (2011). What's so special about slithering serpents? Children and adults rapidly detect snakes based on their simple features. *Visual Cognition, 19,* 129–143. http://dx.doi.org/10.1080/13506285.2010.522216

LoBue, V., & Rakison, D. H. (2013). What we fear most: A developmental advantage for threat-relevant stimuli. *Developmental Review, 33,* 285–303. http://dx.doi.org/10.1016/j.dr.2013.07.005

LoBue, V., Rakison, D. H., & DeLoache, J. S. (2010). Threat perception across the lifespan: Evidence for multiple converging pathways. *Current Directions in Psychological Science, 19,* 375–379. http://dx.doi.org/10.1177/0963721410388801

Mangelsdorf, S. C., Shapiro, J. R., & Marzolf, D. (1995). Developmental and temperamental differences in emotion regulation in infancy. *Child Development, 66,* 1817–1828. http://dx.doi.org/10.2307/1131912

Maretić, Z. (1987). Spider venoms and their effect. In W. Nentwig (Ed.), *Ecophysiology of spiders* (pp. 142–159). Berlin, Germany: Springer. http://dx.doi.org/10.1007/978-3-642-71552-5_11

Marks, I. M. (1987). *Fears, phobias, and rituals*. New York, NY: Oxford University Press.

Marks, I. M., & Nesse, R. M. (1994). Fear and fitness: An evolutionary analyses of anxiety disorders. *Ethology & Sociobiology, 15,* 247–261. http://dx.doi.org/10.1016/0162-3095(94)90002-7

Martin, C. L., & Fabes, R. (2009). *Discovering child development* (2nd ed.). Boston, MA: Houghton Mifflin Company.

Milders, M., Sahraie, A., Logan, S., & Donnellon, N. (2006). Awareness of faces is modulated by their emotional meaning. *Emotion, 6,* 10–17. http://dx.doi.org/10.1037/1528-3542.6.1.10

Möller, E. L., Majdandzic, M., & Bogels, S. M. (2014). Fathers' versus mothers' social referencing signals in relation to infant anxiety and avoidance: A visual cliff experiment. *Developmental Science, 17,* 1012–1028. http://dx.doi.org/10.1111/desc.12194

Muris, P., Merckelbach, H., & Collaris, R. (1997). Common childhood fears and their origins. *Behaviour Research and Therapy, 35,* 929–937. http://dx.doi.org/10.1016/S0005-7967(97)00050-8

Muris, P., Steerneman, P., Merckelbach, H., & Meesters, C. (1996). The role of parental fearfulness and modeling in children's fear. *Behaviour Research and Therapy, 34,* 265–268. http://dx.doi.org/10.1016/0005-7967(95)00067-4

Öhman, A., Flykt, A., & Esteves, F. (2001). Emotion drives attention: Detecting the snake in the grass. *Journal of Experimental Psychology: General, 130,* 466–478. http://dx.doi.org/10.1037/0096-3445.130.3.466

Öhman, A., Fredrikson, M., Hugdahl, K., & Rimmo, P. (1976). The premise of equipotentiality in human classical conditioning: Conditioned electrodermal responses to potentially phobic stimuli. *Journal of Experimental Psychology: General, 105,* 313–337. http://dx.doi.org/10.1037/0096-3445.105.4.313

Öhman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: Toward an evolved module of fear and fear learning. *Psychological Review, 108,* 483–522. http://dx.doi.org/10.1037/0033-295X.108.3.483

Ollendick, T. H., King, H. J., & Muris, P. (2002). Fears and phobias in children: Phenomenology, epidemiology, and aetiology. *Child and Adolescent Mental Health, 7,* 98–106. http://dx.doi.org/10.1111/1475-3588.00019

Ollendick, T. H., & King, N. J. (1991). Origins of childhood fears: An evaluation of Rachman's theory of fear acquisition. *Behaviour Research and Therapy, 29,* 117–123. http://dx.doi.org/10.1016/0005-7967(91)90039-6

Ollendick, T. H., King, N. J., & Frary, R. B. (1989). Fears in children and adolescents: Reliability and generalizability across gender, age, and nationality. *Behaviour Research and Therapy, 27,* 19–26. http://dx.doi.org/10.1016/0005-7967(89)90115-0

Oster, H., Hegley, D., & Nagel, L. (1992). Adult judgments and fine-grained analysis of infant facial expressions: Testing the validity of a priori coding formulas. *Developmental Psychology, 28,* 1115–1131. http://dx.doi.org/10.1037/0012-1649.28.6.1115

Panksepp, J. (2007). Neurologizing the psychology of affects: How appraisal-based constructivism and basic emotion theory can coexist.

Perspectives on Psychological Science, 2, 281–296. http://dx.doi.org/10.1111/j.1745-6916.2007.00045.x

Pierroutsakos, S. L., & Troseth, G. L. (2003). Video verite: Infants' manual investigation of objects on video. *Infant Behavior & Development, 26,* 183–199. http://dx.doi.org/10.1016/S0163-6383(03)00016-X

Poulton, R., & Menzies, R. G. (2002). Non-associative fear-acquisition: A review of the evidence form retrospective and longitudinal research. *Behaviour Research and Therapy, 40,* 127–149. http://dx.doi.org/10.1016/S0005-7967(01)00045-6

Purkis, H. M., & Lipp, O. V. (2009). Are snakes and spiders special? Acquisition of negative valence and modified attentional processing by non-fear-relevant animal stimuli. *Cognition and Emotion, 23,* 430–452.

Rachman, S. J. (1977). The conditioning theory of fear acquisition: A critical examination. *Behaviour Research and Therapy, 15,* 375–387. http://dx.doi.org/10.1016/0005-7967(77)90041-9

Rakison, D. H. (2009). Does women's greater fear of snakes and spiders originate in infancy? *Evolution and Human Behavior, 30,* 438–444. http://dx.doi.org/10.1016/j.evolhumbehav.2009.06.002

Rakison, D. H., & Derringer, J. L. (2008). Do infants possess an evolved spider-detection mechanism? *Cognition, 107,* 381–393. http://dx.doi.org/10.1016/j.cognition.2007.07.022

Rheingold, H. L., & Eckerman, C. O. (1974). Fear of the stranger: A critical examination. *Advances in Child Development and Behavior, 8,* 185–222. http://dx.doi.org/10.1016/S0065-2407(08)60496-6

Ricciuti, H. (1974). Fear and the development of social attachment in the first year of life. In M. Lewis & L. A. Rosenblum (Eds.), *The origins of fear* (Vol. 2, pp. 73–106). New York, NY: Wiley.

Russell, M. J. (1976). Human olfactory communication. *Nature, 260,* 520–522. http://dx.doi.org/10.1038/260520a0

Saarni, C., Campos, J. J., Camras, L. A., & Witherington, D. (2006). Emotional development: Action, communication, and understanding. In N. Eisenberg (Ed.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (6th ed., pp. 226–299). New York, NY: Wiley.

Sampson, R. J. (1987). Personal violence by strangers: An extension and test of the opportunity of model predatory victimization. *The Journal of Criminal Law & Criminology, 78,* 327–356. http://dx.doi.org/10.2307/1143452

Santrock, J. W. (2014). *Child development* (14th ed.). New York, NY: McGraw-Hill.

Scarr, S., & Salapatek, P. (1970). Patterns of fear development during infancy. *Merrill-Palmer Quarterly, 16,* 53–90.

Schaffer, H. R. (1966). The onset of fear of strangers and the incongruity hypothesis. *Journal of Child Psychology & Psychiatry, 7,* 95–106. http://dx.doi.org/10.1111/j.1469-7610.1966.tb02167.x

Schaffer, H. R., & Emerson, P. E. (1964). The development of social attachments in infancy. *Monographs of the Society for Research in Child Development, 29,* 1–77. http://dx.doi.org/10.2307/1165727

Seligman, M. (1971). Phobias and preparedness. *Behavior Therapy, 2,* 307–320. http://dx.doi.org/10.1016/S0005-7894(71)80064-3

Shaffer, D. R., & Kipp, K. (2014). *Developmental psychology: Childhood and adolescence* (9th ed.). Belmont, CA: Wadsworth.

Siegler, R. S., DeLoache, J. S., Eisenberg, N., & Saffran, J. (2014). *How children develop* (4th ed.). New York, NY: Worth. http://dx.doi.org/10.1007/978-1-319-17494-1

Slater, A. M., & Quinn, P. C. (2012). *Developmental psychology: Revisiting the classic studies*. London, UK: Sage.

Smith, P. K. (1974). Social and situational determinants of fear in the playground. In M. Lewis & L. A. Rosenblum (Eds.), *The origins of fear* (Vol. 2, pp. 107–129). New York, NY: Wiley.

Solomon, R., & Decarie, T. G. (1976). Fear of strangers: A developmental milestone or an overstudied phenomenon? *Canadian Journal of Behavioural Science / Revue canadienne des sciences du comportement, 8,* 351–362. http://dx.doi.org/10.1037/h0081961

Sorce, J. F., Emde, R. N., Campos, J. J., & Klinnert, M. D. (1985). Maternal emotional signaling: Its effects on the visual cliff behavior of 1-year-olds. *Developmental Psychology, 21,* 195–200. http://dx.doi.org/10.1037/0012-1649.21.1.195

Spitz, R. A. (1950). Anxiety in infancy: A study of its manifestations in the first year of life. *The International Journal of Psychoanalysis, 31,* 138–143.

Sroufe, L. A. (1977). Wariness of strangers and the study of infant development. *Child Development, 48,* 731–746. http://dx.doi.org/10.2307/1128323

Sroufe, L. A. (1997). *Emotional development: The organization of emotional life in the early years*. Massachusetts: Cambridge University Press.

Tamis-LeMonda, C. S., Adolph, K. E., Lobo, S. A., Karasik, L. B., Dimitropoulou, K. A., & Ishak, S. (2008). When infants take mothers' advice: 18-month-olds integrate perceptual and social information to guide motor action. *Developmental Psychology, 44,* 734–746. http://dx.doi.org/10.1037/0012-1649.44.3.734

Tennes, K. H., & Lampl, E. E. (1964). Stranger and separation anxiety in infancy. *Journal of Nervous and Mental Disease, 139,* 247–254. http://dx.doi.org/10.1097/00005053-196409000-00005

Thrasher, C., & LoBue, V. (2016). Do infants find snakes aversive? Infants' physiological responses to "fear-relevant" stimuli. *Journal of Experimental Child Psychology, 142,* 382–390. http://dx.doi.org/10.1016/j.jecp.2015.09.013

Ueno, M., Uchiyama, I., Campos, J. J., Anderson, D. I., He, M., & Dahl, A. (2018). Crawling experience relates to postural and emotional reactions to optic flow in a virtual moving room. *Journal of Motor Learning and Development, 6,* S63–S75.

Ueno, M., Uchiyama, I., Campos, J. J., Dahl, A., & Anderson, D. I. (2012). The organization of wariness of heights in experienced crawlers. *Infancy, 17,* 376–392. http://dx.doi.org/10.1111/j.1532-7078.2011.00083.x

Walk, R. D. (1966). The development of depth perception in animals and human infants. *Monographs of the Society for Research in Child Development, 31*(5, Serial No. 107).

Walk, R. D., & Gibson, E. J. (1961). A comparative and analytical study of visual depth perception. *Psychological Monographs, 75*(15, Whole No. 519).

Walk, R. D., Gibson, E. J., & Tighe, T. J. (1957). Behavior of light- and dark-reared rats on a visual cliff. *Science, 126,* 80–81. http://dx.doi.org/10.1126/science.126.3263.80-a

Waters, E., Matas, L., & Sroufe, L. (1975). Infants' reactions to an approaching strange: Description, validation, and functional significance of wariness. *Child Development, 46,* 348–356. http://dx.doi.org/10.2307/1128127

Witherington, D. C., Campos, J. J., Anderson, D. I., Lejeune, L., & Seah, E. (2005). Avoidance of heights on the visual cliff in newly walking infants. *Infancy, 7,* 285–298. http://dx.doi.org/10.1207/s15327078in0703_4

Witherington, D. C., & Crichton, J. A. (2007). Frameworks for understanding emotions and their development: Functionalist and dynamic systems approaches. *Emotion, 7,* 628–637. http://dx.doi.org/10.1037/1528-3542.7.3.628

Received November 27, 2017
Revision received November 6, 2018
Accepted November 11, 2018 ■